U.S. DEPARTMENT OF COMMERCE
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GRADD Regional Solid Waste Plan

Green River Area Development District, Greer boro, Ky

Prepared for

Environmental Protection Agency, Washington, D C Office of Solid Waste Management Programs

May 75

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PB 258 260

GRADD REGIONAL SOLID WASTE PLAN

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The GRADD Solid Waste Project sees two management possibilities for the seven-county region. Each county could elect to "to it alone" with individual rural collection systems. The other alternative provides joint operation across the region. The individual operations will provide many local controls. The regional system should be more efficient and cost-effective. A key element in this plan is compatibility. Each collection system should specify the same type of collection equipment (frong-end loaders). This will allow the development of joint service by stages in "building block" fashion. Compatible collection equipment allows neighboring governments to share equipment in the event of breakdowns. Resource recovery is a major element in plan design. The population base is not adequate to support intensive resource recovery from residential waste at the present time. The plan also provides for reclamation of selected abandoned strip mines. Land is a valuable resource. Use of refuse to return this wasted land to use for agriculture or recreation is a valuable form of resource recovery. Concentrating the waste in three regional landfills allows an easy shift to more intensive resource recovery should market conditions change. There is the possibility of establishment of a plant to recover metals from waste and burn the remainder to generate electric power. Landfills could easily become transfer stations moving the waste to the processing plant.

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SOLID WASTE PLAN

May 1975

PREPARED BY
GREEN RIVER AREA DEVELOPMENT DISTRICT
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from the United States Environmental Protection Agency,
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CAUTION!

Readers are cautioned that this plan reflects prices at the time of writing. For the most part, they reflect the situation in early 1974. Inflation and changing fuel costs will affect capital and operating costs. The markets for recycled materials can change rapidly. All prices should be verified before taking any action.

i. summary and recommendations

SUMMARY AND RECOMMENDATIONS

The GRADD Solid Waste Project sees two management possibilities for the seven county region. Each county could elect to "go it alone" with individual rural collection systems. The other alternative provides joint operation across the region. The individual operations will provide many local controls. The regional system should be more efficient and cost effective.

In either alternative, cities could elect to join the system or continue to provide their own services. The most feasible choice for most cities is to continue to provide collection service and contract for disposal in an areawide landfill. Joint agreements are now in force in the region.

The regional plan is flexible. The choice is made at the local level. The system is viable even if a unit of government decides not to join.

A key element in this plan is compatibility. Each collection system should specify the same type of collection equipment (front end loaders). This will allow the development of joint service by stages in "building block" fashion. Compatible collection equipment allows neighboring governments to share equipment in the event of breakdowns.

The ultimate system would provide a "green box" collection system with front end loader packer trucks in the rural areas. Incorporated towns would provide a mix of house to house collection with green boxes. Disposal would be in three regional landfills.

Resource recovery is a major element in plan design. The population base is not adequate to support intensive resource recovery from residential waste at the present time. Material recovery is profitable from selected industrial waste. These existing private operations should be encouraged and expanded. The plan also provides for reclamation of selected abandoned strip mines. Land is a valuable resource. Use of refuse to return this wasted land to use for agriculture or recreation is a valuable form of resource recovery.

Concentrating the waste in three regional landfills allows an easy shift to more intensive resource recovery should market conditions change. There is the possibility of establishment of a plant to recover metals from waste and burn the remainder to generate electric power. Landfills could easily become transfer stations moving the waste to the processing plant.

ii. base data

BASE DATA

1. POPULATION

The 1970 Census showed a total population of 179,613 for the seven county Green River Region.[1] Urban dwellers number 83,760.[2] Most of the region's urban dwellers are provided with municipal solid waste collection and disposal service.

The rural half of the population frequently does not have adequate solid waste collection and disposal service. One assumption frequently made is that rural people can dispose of solid waste on the farm. However, in the GRADD, non farm residents outnumber farm residents in every county.

Farm dwellers are faced with multiple hazards, e.g., toxic chemicals, pesticides, etc., which complicate the disposal problems.

Population Distribution

County:	Percent Rural Farm	Percent R. Non-Farm	Percent Rural	Percent Urban
Daviess	10.1	22.7	32.8	67.2
Hancock	27.7	72.3	100.0	----
Henderson	12.0	24.3	36.3	63.7
McLean	33.8	66.2	100.0	----
Ohio	30.2	55.8	86.0	14.0
Union	16.0	61.6	77.6	22.4
Webster	16.1	52.0	68.1	31.9

Source Bureau of the Census **1970 Census of Population**

The rural population is scattered. This fact pushes operating costs higher, particularly if individual pick up is made at each home and place of business.

(1) Bureau of the Census, U.S. Department of Commerce **1970 Census of Population**, General, Social and Economic Characteristics

(2) By Census definition, urban includes cities with a population of 2500 or more. All other regions are classified as rural.

TABLE 1

POPULATION DENSITY

County	Population	Sq. Miles	Density Per Sq. Mi.	Median Persons Per Household
Daviess	79,486	466	171	2.9
Hancock	7,080	187	38	3.0
Henderson	36,031	440	82	2.7
McLean	9,062	257	35	2.5
Ohio	18,790	596	32	2.5
Union	15,882	343	46	2.6
Webster	13,282	339	39	2.4
GRADD	179,613	2,628	68	

Sources: **Green River Area Development District GRADDATA** and 1970 Census

Detailed census information, presented by county division, is included to aid in evaluating operations. Another table presents data for cities as reported by the Bureau of the Census.

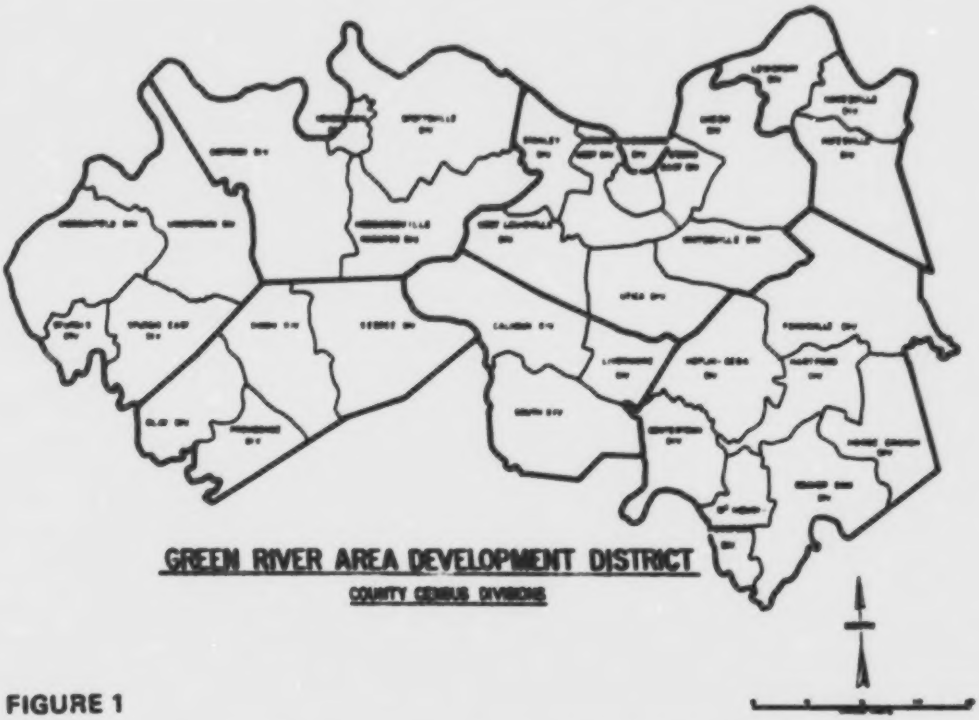
GREEN RIVER AREA DEVELOPMENT DISTRICT
COUNTY CENSUS DIVISIONS

FIGURE 1

TABLE 2
CENSUS DIVISION
POPULATION CHANGE

COUNTY SUBDIVISIONS	1970	1960	% CHANGE
DAVIESS	79,486	70,588	12.6
Maceo Division	5,456	4,779	14.2
Owensboro Division	50,864	42,743	19.0
–Owensboro City	50,329	42,471	18.5
Owensboro East Division	7,753	5,755	34.7
Owensboro West Division	2,952	5,171	–42.9
Stanley Division	3,188	3,048	4.6
Utica Division	2,685	2,874	–6.6
West Louisville Division	2,382	2,631	–9.5
Whitesville Division	4,206	3,587	17.3
–Whitesville City	752	713	5.5
HANCOCK	7,080	5,330	32.8
Hawesville Division	2,786	2,194	27.0
–Hawesville City	1,262	882	43.1
Lewisport Division	2,695	1,614	67.0
–Lewisport City	1,595	610	161.5
Patesville Division	1,599	1,522	5.1
HENDERSON	36,031	33,519	7.5
Corydon Division	5,364	5,144	4.3
Hebbardsville Robards Division	2,832	2,856	–0.8
Henderson Division	23,311	16,892	38.0
–Corydon City	880	746	18.0
Spottsville Division	4,524	4,427	2.2
MCLEAN	9,062	9,355	–3.1
Calhoun Division	3,069	3,006	2.1
–Beech Grove City	233	159	46.5
–Calhoun City	901	817	10.3
Livermore Division	2,757	2,710	1.7
–Livermore City	1,594	1,506	5.8
South Division	3,236	3,639	–11.1
–Island City	410	462	–11.3
–Sacramento City	437	429	1.9
OHIO	18,790	17,725	6.0
Beaver Dam Division	5,359	4,350	23.2
–Beaver Dam City	2,622	1,648	59.1
Centertown Division	1,244	1,468	–15.3
–Centertown City	323	327	–1.2
Fordsville Division	2,586	2,656	–2.6
–Fordsville City	489	524	–6.7
Hartford Division	3,394	3,255	4.3
–Hartford City	1,868	1,618	15.5
Heflin Beda Division	2,216	1,939	14.3
Horse Branch Division	1,781	1,775	0.3
McHenry Rockport Division	2,210	2,282	–3.2
–McHenry City	420	446	–5.8
–Rockport City	377	396	–4.8
UNION	15,882	14,537	9.3
Morganfield Division	5,288	5,465	–3.2
–Morganfield City	3,563	3,741	–4.8
Sturgis East Division	1,786	1,836	–2.7
Sturgis West Division	3,300	3,648	–9.5
–Sturgis City	2,210	2,209	––
Uniontown Division	5,508	3,588	53.5
–Uniontown City	1,255	1,255	––
–Waverly City	355	311	1.2
WEBSTER	13,282	14,244	–6.8
Clay Division	2,617	2,888	–9.4
–Clay City	1,426	1,343	6.2
–Wheatcroft City	229	317	–27.8
Dixon Division	1,910	2,012	–9.1
–Dixon City	572	541	5.7

TABLE 2 - (cont'd)

CENSUS DIVISION - POPULATION CHANGE

Providence Division	5,040	5,476	−8.0
–Providence City	4,270	3,771	13.2
Sebree Division	2,715	2,778	−1.7
–Sebree City	1,092	1,139	−4.1
–Slaughtersville City	276	284	−2.8

Source: **1970 Census of Population**

A. POPULATION CHANGE

The following table shows historical population change since 1950 and projections of population to 2020. The staff of the GRADD suggests that these projections may be conservative. Industrial growth in the coal-rich Ohio Valley may spur increases beyond these projections.

Solid waste operators will need to take these growth factors into account in planning future operations. More equipment and staff will be required to serve an expanding population. In addition to residential growth, commercial and industrial facilities will need to be served. Recycling facilities and ultimate disposal facilities must be large enough to handle growth expected during the life of the facility.

TABLE 3

POPULATION PROJECTIONS

GREEN RIVER ADD

County	1970*	1975	1980	1990	2000	2020
Daviess	79,486	84,134	91,009	106,976	125,333	168,828
Hancock	7,080	7,832	8,731	11,077	14,091	22,482
Henderson	36,031	37,756	39,778	44,448	49,751	61,712
McLean	9,062	9,086	9,173	9,308	9,456	9,724
Ohio	18,790	19,010	19,379	20,497	21,892	24,911
Union	15,882	16,340	16,920	18,406	20,070	23,190
Webster	13,282	13,419	13,684	14,585	15,948	19,284
Total	179,613	187,577	198,674	225,297	256,541	330,131

*Actual census figures presented for comparison purposes.

Source: Spindletop Research, Inc., and **U.S. Census of Population, 1970.**

TABLE 4

CITY AND COUNTY

CENSUS
POPULATION CHANGE
GREEN RIVER AREA DEVELOPMENT DISTRICT

CITY	COUNTY	1970	1960	% CHANGE
Owensboro	Daviess	50,329	42,471	18.5
Whitesville	Daviess	752	713	5.5
Hawesville	Hancock	1,262	882	43.1
Lewisport	Hancock	1,595	610	161.5
Henderson	Henderson	22,976	16,892	36.0
Corydon	Henderson	880	746	18.0
Beech Grove	McLean	233	159	46.5
Calhoun	McLean	901	817	10.3
Island	McLean	410	462	-11.3
Livermore	McLean	1,594	1,506	5.8
Sacramento	McLean	437	429	1.9
Beaver Dam	Ohio	2,622	1,648	59.1
Centertown	Ohio	323	327	-1.2
Fordsville	Ohio	489	524	-6.7
Hartford	Ohio	1,868	1,618	15.5
McHenry	Ohio	420	446	-5.8
Rockport	Ohio	377	396	-4.8
Sturgis	Union	2,210	2,209	-
Morganfield	Union	3,563	3,741	-4.8
Uniontown	Union	1,255	1,255	-
Waverly	Union	335	331	1.2
Clay	Webster	1,426	1,343	6.2
Dixon	Webster	572	541	5.7
Providence	Webster	4,270	3,771	13.2
Sebree	Webster	1,092	1,139	-4.1
Slaughters	Webster	276	284	-2.8
Wheatcroft	Webster	229	317	-27.8
	DAVIESS	79,486	70,588	12.6
	HANCOCK	7,080	5,330	32.8
	HENDERSON	36,031	33,519	7.5
	MCLEAN	9,062	9,355	-3.1
	OHIO	18,790	17,725	6.0
	UNION	15,882	14,537	9.3
	WEBSTER	13,282	14,244	-6.8
	GRADD	179,613	165,298	8.6

Source: **1970 Census of Population.**

2. ECONOMIC OVERVIEW

The Green River Area Development District is a seven county region in northwestern Kentucky. The Ohio River forms the northern boundary of the District. The Green River flows north into the Ohio, dividing the District into two almost equal sections.

Regional studies (e.g., **The Green River ADD Regional Overall Economic Development Program** (OEDP)) contain a wealth of economic information. This overview is intended only to highlight salient points for solid waste programs. Detailed information can be obtained from the GRADD staff.

Coal is a major natural resource, underlying practically the entire District in commercial quantities. Active mines operate throughout the District. Petroleum is also available. Agriculture is a major factor in the economy of the region. Manufacturing activities tend to concentrate near the Green and Ohio rivers.

Aluminum, steel, and chemicals are the main primary manufacturing products. A recent report indicated a prime potential for the following industries: steel, aluminum, metal products, industrial chemicals, plastics and similar synthetic products, paper and paper products, wearing apparel and shoes.[1]

The following table sketches the employment data for 1972:

TABLE 5

EMPLOYMENT AND UNEMPLOYMENT

COUNTY	AGRI.	MFG.	GOV.	TRADE/ SERV.	TOTAL*	UNEMP. RATE
Daviess	1,540	8,210	2,720	8,473	31,980	4.3%
Hancock	400	2,550	220	171	4,090	3.0%
Henderson	920	3,410	1,470	3,707	13,980	3.4%
McLean	590	370	330	303	2,120	8.8%
Ohio	1,000	1,110	760	721	5,870	4.4%
Union	580	520	440	1,511	5,890	2.8%
Webster	630	440	550	500	4,230	5.6%
GRADD	5,660	16,610	6,490	15,116	68,160	

*Total includes other miscellaneous groups not tabulated here

SOURCE: Kentucky Dept. of Commerce **Kentucky Deskbook of Economic Statistics, 1973.**

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(1) Kentucky Department of Commerce **A Place to Grow**, 1973

The following three maps indicate major transportation networks in the region.

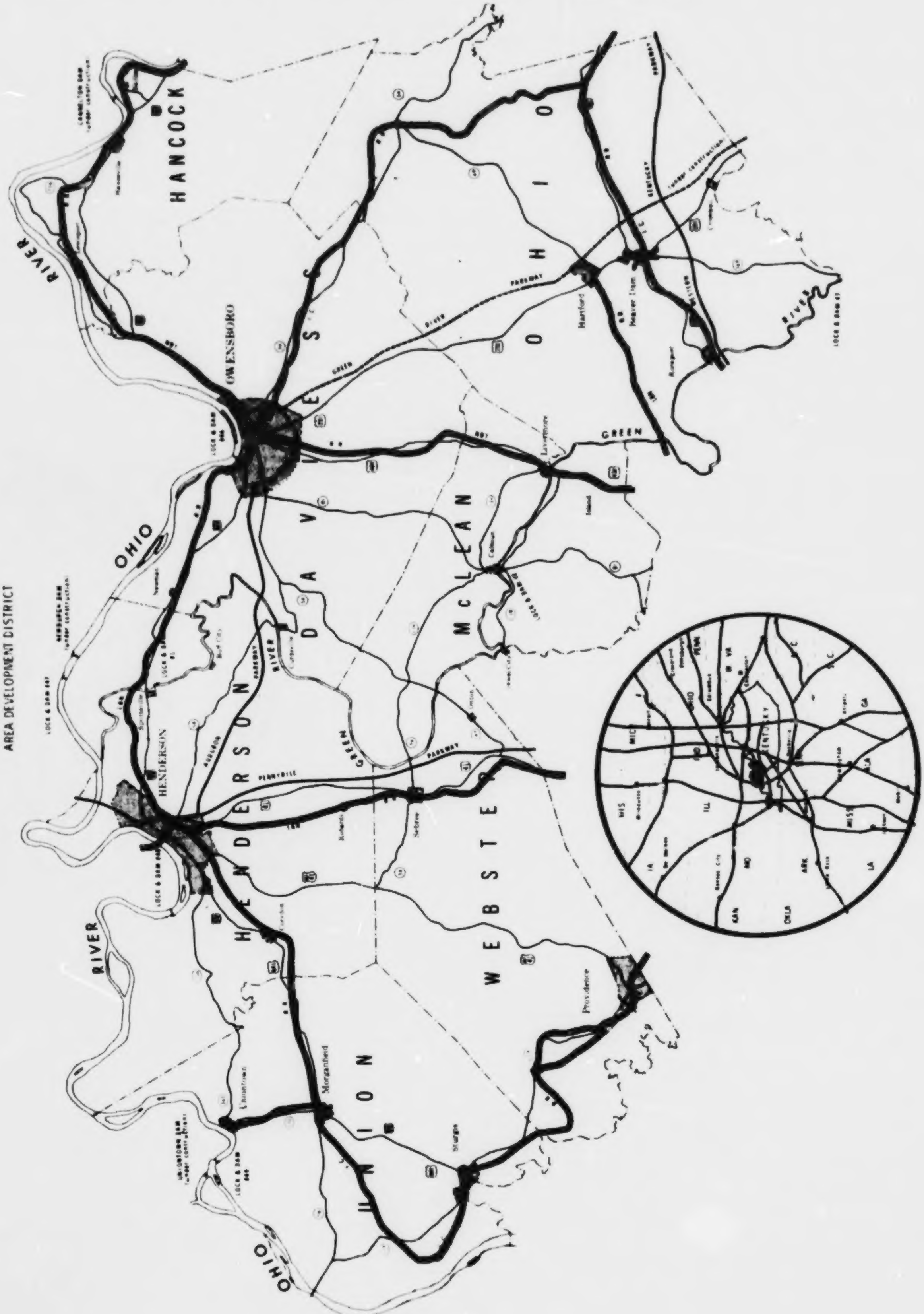

HANCOCK
DAVIESS
OHIO
McLEAN
HENDERSON
WEBSTER
UNION
OWENSBORO
HENDERSON
OHIO RIVER
OHIO RIVER
GREEN RIVER
GREEN
Hartford
Livermore
Calhoun
Sebree
Providence
Morganfield
Sturgis
Uniontown
PARKWAY
KENTUCKY

FIGURE 2
RAILWAY NETWORK
GREEN RIVER
AREA DEVELOPMENT DISTRICT

FIGURE 3

HIGHWAY NETWORK
GREEN RIVER
AREA DEVELOPMENT DISTRICT

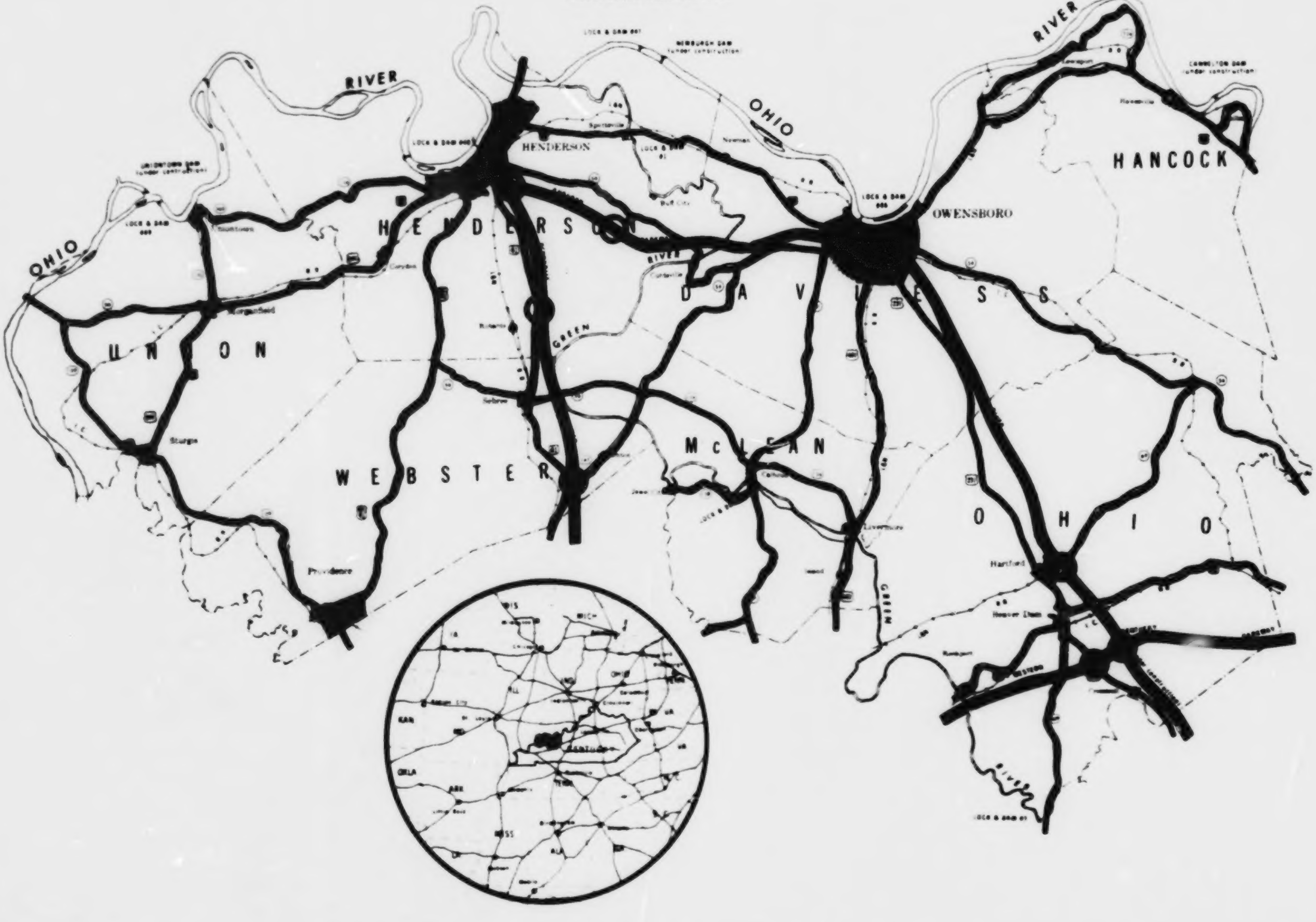
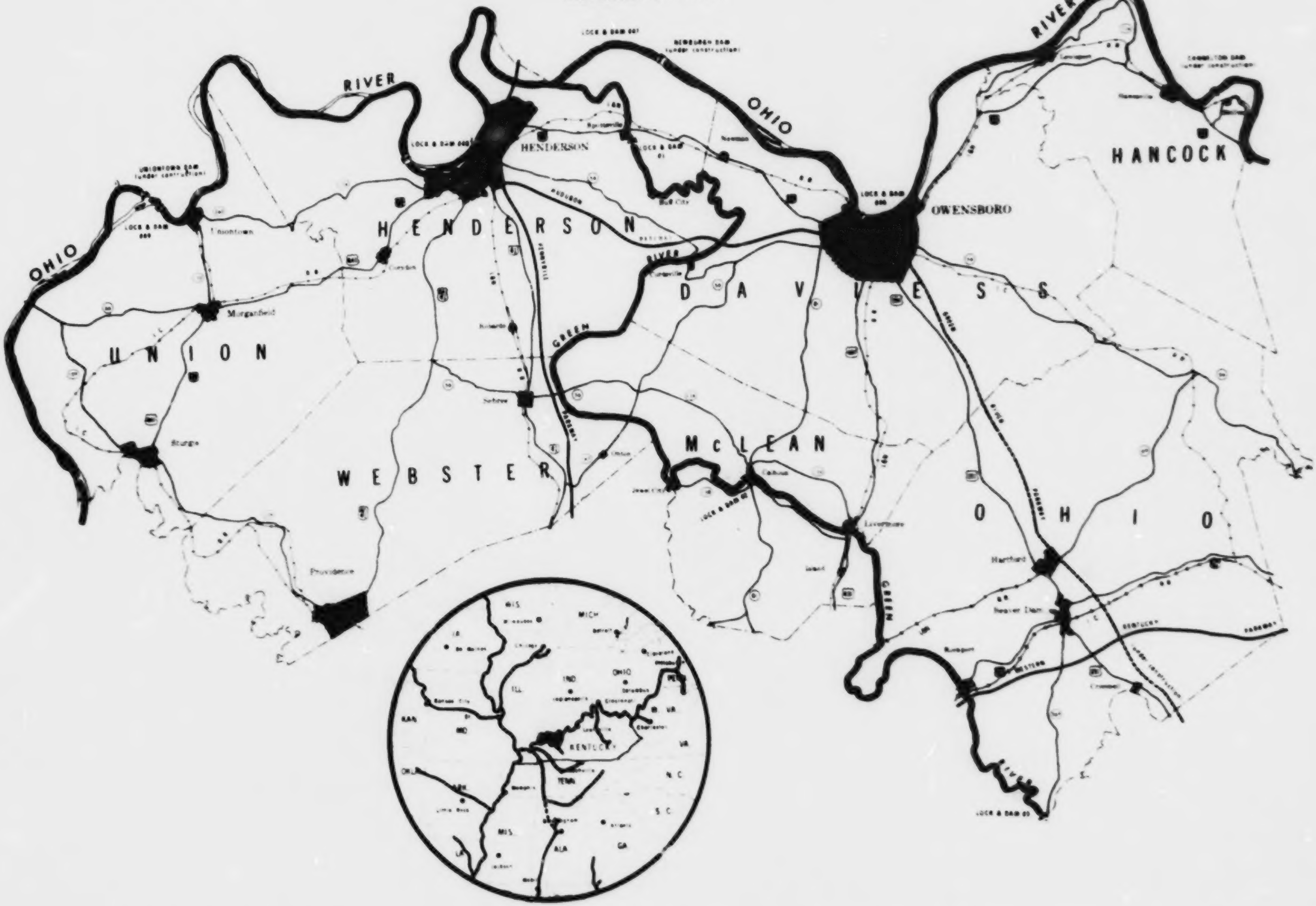

OHIO
RIVER
OHIO
RIVER
HENDERSON
OWENSBORO
HANCOCK
UNION
HENDERSON
WEBSTER
McLEAN
DAVIESS
OHIO
GREEN
GREEN
RIVER
GREEN
Sturgis
Morganfield
Providence
Sebree
Hartford
Livermore
Beaver Dam
LOCK & DAM
NEWBURGH DAM (under construction)
UNIONTOWN DAM (under construction)
CANNELTON DAM (under construction)

FIGURE 4

WATERWAY NETWORK
GREEN RIVER
AREA DEVELOPMENT DISTRICT


OHIO
RIVER
OHIO
RIVER
GREEN
RIVER
GREEN
RIVER
HENDERSON
UNION
WEBSTER
DAVIESS
McLEAN
OHIO
HANCOCK
HENDERSON
OWENSBORO
Uniontown
Morganfield
Sturgis
Corydon
Sebree
Providence
Calhoun
Livermore
Hartford
Beaver Dam
Rumsey
LOCK & DAM
UNIONTOWN DAM (under construction)
NEWBURGH DAM (under construction)
CANNELTON DAM (under construction)
LOCK & DAM 46
PARKWAY
KENTUCKY
TENN
OHIO
IND
ILL
MICH
MO
KAN
VA
N C
S C
GA
ALA
MIS
OKLA

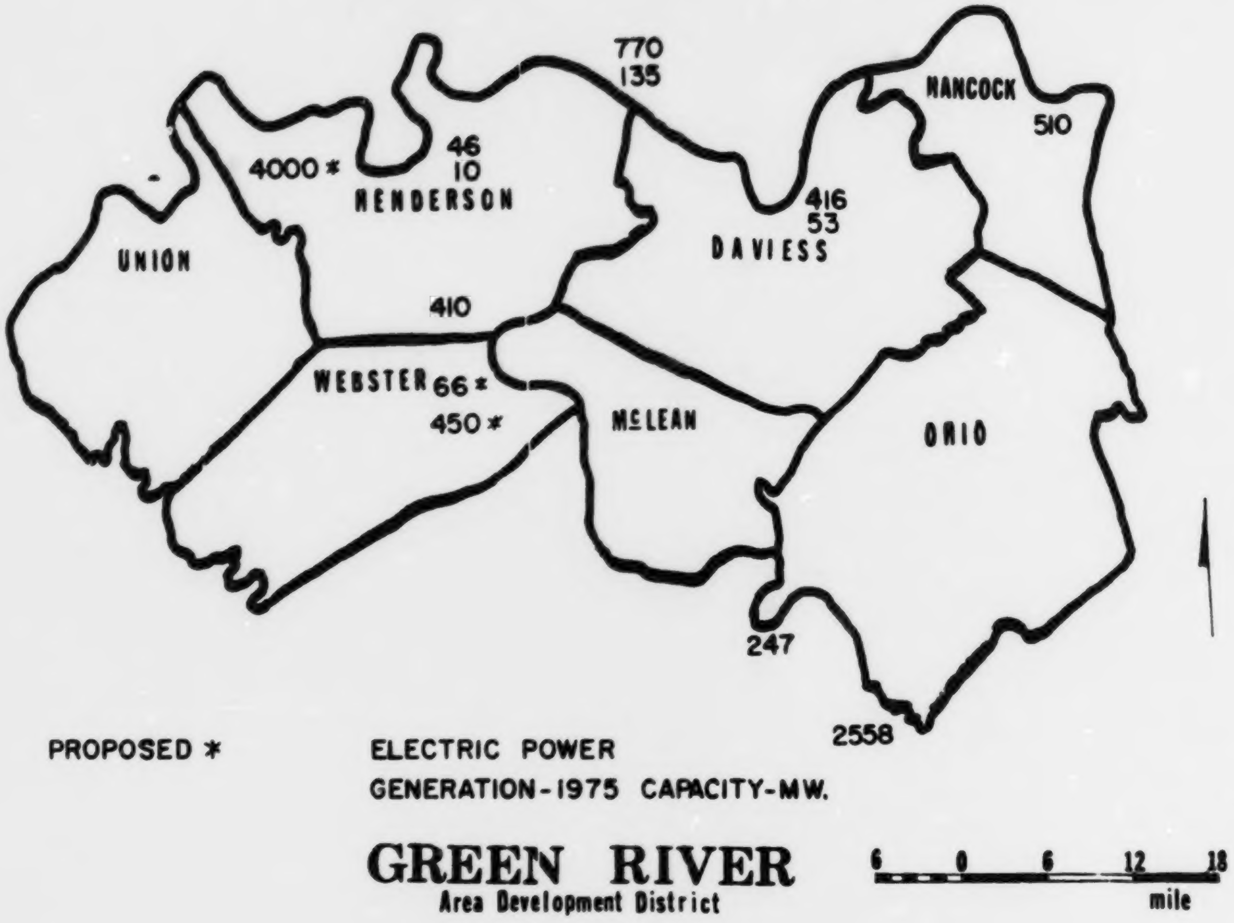
3. ENERGY

Coal is the prime energy resource of the District. The Kentucky Department of Commerce estimates there are 37,000,000,000 tons of coal reserves in and around the District.[1] The same source estimated 1970 crude oil production at 6,300,000 barrels for the seven-county region.

The river network and coal reserves provide resources for electric power generation. Existing capacity is 3,600,000 kilowatts. Additional generating capacity is found nearby. Existing and proposed facilities are located on the attached map.

Electric power generation is a major factor in the solid waste plan. Coal mining provides potential waste disposal sites. Power generation produces ash which must be disposed of or used. Some processes can use solid waste as a fuel component.

FIGURE 5


770
135
HANCOCK
510
46
10
4000 *
HENDERSON
416
53
DAVIESS
UNION
410
WEBSTER
66 *
450 *
McLEAN
OHIO
247
2558
PROPOSED *
ELECTRIC POWER
GENERATION-1975 CAPACITY-MW.
GREEN RIVER
Area Development District
6
0
6
12
18
mile

4. EXISTING LAND USES

Each of the GRADD's seven counties has been surveyed to determine the exact use of county land. A composite of these surveys indicates that the GRADD has a total area of 1,681,920 acres or 2,628 square miles.

The predominant use of land is for agricultural purposes with 784,100 acres being used for crops, 206,900 acres in pasture, and 531,000 acres in forest.

The second largest use of GRADD land is for public and semi-public development which amounts to 38,695 acres, most of which is developed for roads, highways, and streets.

Residential uses are scattered throughout the District with concentration being located within the incorporated cities. Land being used for residential development amounts to some 24,680 acres. Occupying this residential acreage are 50,280 single-family units, 6,855 multi-family units, and 2,948 mobile home units.

Surveys indicate that there are 4,014 acres within the GRADD being used for industrial purposes. Although statistics were not available, it is a known fact that much of the land presently being used for agricultural purposes is owned by large industrial companies and may eventually be developed for industrial use.

Commercial land uses occupy 1,689 acres of land with concentrations being in and around the cities and towns of GRADD.

Table 6 presents the various land use categories and the acreage devoted to each use. Figure 6 indicates the patterns of possible future land use. Detailed land use plans for each county are available from the GRADD office.

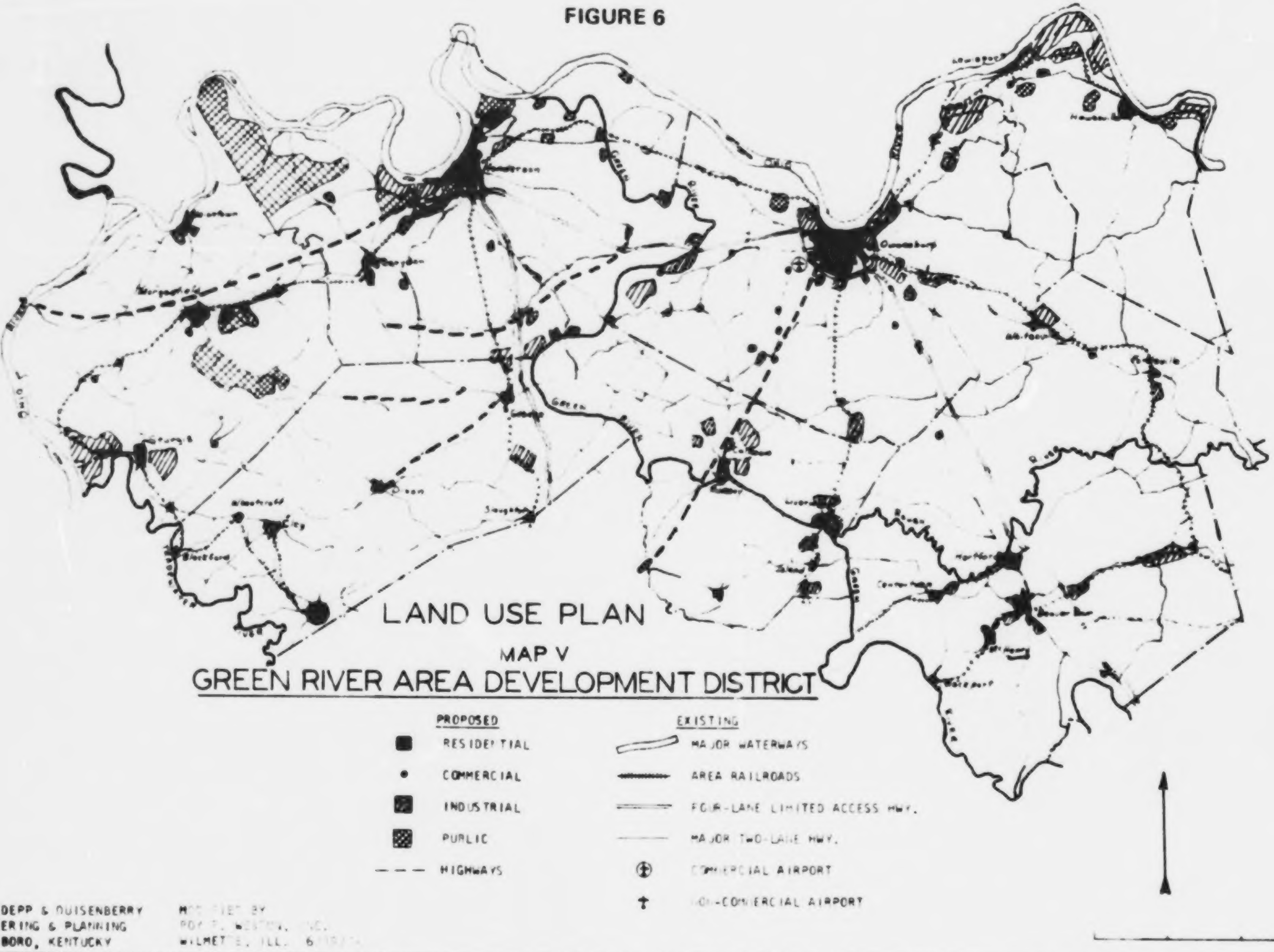
TABLE 6
EXISTING LAND USES
GREEN RIVER AREA DEVELOPMENT DISTRICT

LAND USE CATEGORY	DAVIESS Acres	HANCOCK Acres	HENDERSON Acres	McLEAN Acres	OHIO Acres	UNION Acres	WEBSTER Acres	TOTAL Acres
Residential	6,248	1,622	4,249	3,191	3,352	4,068	1,940	24,680
Commercial	515	46	763	61	112	107	85	1,689
Industrial	1,015	904	1,680	103	29	133	150	4,014
Public & Semi-Public	6,497	6,487	3,904	6,756	8,250	8,250	5,780	38,965
TOTAL DEVELOPED	14,275	3,863	13,189	7,259	10,249	12,558	7,955	69,348
VACANT AND/OR AGRICULTURAL	283,965	115,817	268,411	157,220	371,191	206,963	209,005	1,612,572
GRAND TOTAL	298,240	119,680	281,600	164,479	381,440	219,521	216,960	1,681,920

NOTE Information for this table was taken in part from the individual County's Comprehensive Planning Reports and from field data.

SOURCE GRADD **Comprehensive Water and Sewer Plan** prepared by Roy F. Weston, Inc., 1972

FIGURE 6


LAND USE PLAN
MAP V
GREEN RIVER AREA DEVELOPMENT DISTRICT
PROPOSED
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PUBLIC
HIGHWAYS
EXISTING
MAJOR WATERWAYS
AREA RAILROADS
FOUR-LANE LIMITED ACCESS HWY.
MAJOR TWO-LANE HWY.
COMMERCIAL AIRPORT
NON-COMMERCIAL AIRPORT
Owensboro
Henderson
Ohio
Green

JOHNSON, DEPP & QUISENBERRY
ENGINEERING & PLANNING
OWENSBORO, KENTUCKY

MODIFIED BY
ROY F. WESTON, INC.
WILMETTE, ILL.

iii. existing services

EXISTING SERVICES

A survey of existing solid waste services in each county was carried out in the District. Because of lack of record keeping in some counties, exact facts were not available about the total number of customers in each service, cost of operation and maintenance, and services provided by small contractors. In the District, 14 public and 20 private companies involved in solid waste collection and disposal were identified. The public services are provided in residential and commercial areas of the cities and counties, while the private companies serve more remote residential, commercial, and most industrial areas. (See Figure 7 for a general map of existing services.) The private companies also serve some schools and trailers parks in the District which are not shown on the map. Open burning and roadside dumping are common wherever there is no collection service.

1. COLLECTION

Daviess County:

This major urban county of the District is being served by various types of collection ranging from house-to-house service to containerized collection. There are five private collectors in the county. Their service extends from industrial and commercial areas of the City of Owensboro to the more densely populated areas of the county. At present, most of the rural residents do not have any type of collection service.

The City of Owensboro has municipal sanitation service providing house-to-house, carry out-carry back collection to the residents, and containerized collection collection to businesses, schools, and hospitals with frequency depending on volume. The residential backyard waste collection is provided by seven 38 cu. yd. tractor trailers, and four 20 cu. yd. packer trucks. The refuse cans are emptied in the garbage truck which transports directly to the city landfill. A small transfer station is used for wastes collected from commercial operations, hospitals and schools. Service for the transfer station is provided by three 38 cu. yd. transfer trailers. The transfer station is ten miles from the landfill. The labor force of the city sanitation service includes 14 drivers, 2 supervisor/drivers, and 70 crewmen. The services include garbage collection, leaf collection, and street sweeping. Recently, the city bought one 30 cu. yd. front end loader and about 60 containers to replace the dumpster hoist system in commercial areas, hospitals, and schools. At present, the residents are charged $3.00 per house per month for refuse collection. The business and other users are charged on a sliding scale depending on volume.

Hancock County:

This is the first county in the GRADD which formed a county garbage and refuse district under KRS 109 (see Legal Section). The county is operating only the disposal site. Collection in the rural area is franchised with a private collector. This private collection firm also operates in the two incorporated cities of the county and nearby residential and commercial areas. The collection system, with house-to-house or curb service, uses one packer truck (15 cu.yd.) and provides twice-a-week service for $3.50 per house per month. The major industries in the county have their own collection systems or use contract operators, while the commercial operations and schools use private collectors or practice open burning. The County Fiscal Court is in the process of setting up a countywide containerized solid waste collection system.

Henderson County:

There are two major refuse collection agencies in this county, the Henderson County Sanitation (Fiscal Court) Department, serving the county outside Henderson city limits, and the City of Henderson Sanitation Department, serving residential areas and businesses in the city. A small private company partially serves residents in the City of Corydon.

The county sanitation department is comprised of a containerized collection system using sixty 6 cu. yd. containers strategically placed at different locations in the county and serviced by a 30 cu. yd. front end loader. The frequency of service varies at different sites depending on the supervisor's judgment. The county garage is used as the maintenance and administrative office, and the county highway department helps to prepare and maintain the container sites. This system is about two years old and is unique in this district for rural waste collection.

The Henderson city sanitation system, operated under the city public works department, provides refuse collection service to residential and commercial areas, hospitals and other institutions except industries. This house-to-house backyard collection system uses five 16 cu. yd. rear loader packer trucks. About two trips are made daily by each truck. The personnel of the system includes a supervisor, five drivers, and 14 crewmen. Each household unit in the city is charged $2.50 per month for refuse collection, while the charge for commercial and other areas varies according to the volume of the refuse. The city has installed a scale at the disposal site which enables full records to be kept of the collection system.

There are three private collectors serving industries in the county. Most of the industries and major commercial areas operate their own collection systems and pay a disposal charge of $1.70 per ton at the city landfill.

McLean County:

The solid waste collection service in this county is financed through the general funds of the county fiscal Court. The cities of Livermore, Beech Grove, Calhoun, Sacramento, and other main roads are served by this collection operation. There are no scheduled days of collection and the service is not provided to all residents. The county uses 1½ ton truck for once-a-week curb or alley waste collection. About one fourth of the county receives this service.

Because of the inadequacy of this service, the cities of Livermore and Sacramento have franchised private collectors. Use of this service is not mandatory for the residents. The private contractor serves about 400 homes with one 2½ ton truck and a 12 cu. yd. rear loader. The system uses twice-a-week backyard collection. There is no limit on the number of cans and $3.50 per home per month is charged for the service.

Ohio County:

The Ohio County Sanitation Department financed by the Fiscal Court operates a landfill, but the waste collection in the rural area is provided by private haulers. The waste from the cities of Hartford and Beaver Dam is collected by the cities with two 2½ ton trucks, and a 5 cu. yd. rear loader. This house-to-house waste collection service is provided twice weekly for the service charge of $3.00 per home/month. This service is not mandatory for city residents. Because of this, residents in the southern and western parts of the cities are using services from private haulers.

The private haulers are servicing densely populated rural areas with a 16 cu.yd. rear loader. This service is also extended to the commercial areas with the frequency depending on the volume. The service charge for residential customers is $4.00 per month, while the commercial rate varies with the volume.

Union County:

The City of Morganfield has a well established set out-set back collection service. One 16 cu. yd. rear loader packer truck with a 13 cu.yd. back-up packer unit serves residential units. Containers are placed at different commercial areas. The frequency of collection is weekly for residential and twice weekly for commercial units with $2.50 and $5.00 per month service charges respectively. About two truck loads of refuse per day are hauled to the city landfill located approximately three miles outside the city.

The City of Sturgis provides house-to-house alley service with an 18 cu. yd. rear loading packer truck. The commercial units are serviced with one and two cu.yd. rear loading containers with varying frequency of collection. The service charge is $2.00 per house per month. About five loads per week are hauled to a private landfill in Wheatcroft about 12 miles from the city.

The City of Uniontown also provides weekly house-to-house collection with a 16 cu.yd. rear loading packer truck. Service is also provided to the commercial units in the city. The city hauls five truck loads of refuse per week to the private landfill in Wheatcroft about 30 miles from the city.

The private haulers in the rural areas provide house-to-house service to residential units and also serve commercial and industrial areas. Equipment varies from one-half ton pickup trucks to a 12 cu. yd. rear load packer truck. The service charge for this once-a-week service varies from $2 to $5 per house per month. They haul the refuse to the City of Morganfield landfill.

There is no county-operated collection system at present. Recently, the county formed a solid waste collection district under KRS 109 (see Legal Section). The system is under development for possible operation in 1975.

Webster County:

The City of Providence now has a city-operated service providing weekly house-to-house collection with an 18 cu. yd. rear load packer truck. The waste is hauled to the private landfill in Wheatcroft about 12 miles from the city.

The City of Sebree and the new City of Clay refuse collection systems also use small packer trucks with weekly collection.

There is no county-operated collection system in the rural part of the county. The private haulers provide services in the City of Dixon and some densely populated rural areas. There is a well-operated disposal site in the county.

2. DISPOSAL

The solid waste disposal practices in the rural area of GRADD have varied from roadside dumps to well operated and maintained landfills. During the initial field survey, we came across numerous roadside dumps and burning dumps which were remotely located and operated by private and public agencies. The disposal practices in a community are directly dependent on the availability of a collection service. Table 7 and the general map in the appendix outline the existing landfills. Each county has at least one sanitary landfill in operation but, because of the lack of a solid waste collection system in most cities and rural areas, indiscriminate dumping has been frequent.

Public education and awareness of local government during the course of this planning program have eliminated some of these illegal dumps.

As shown in Table 7, there are 10 sanitary landfills in the District, one in each county except Daviess (3 landfills) and Henderson (2 landfills). Seven landfills are operated by city or county governments; two are operated by private haulers (in Daviess and Webster counties); and one is an industrial landfill operated by Anaconda Aluminum Company (in Henderson County).

Facilities at the landfills vary from equipment shed and fence (Hancock, McLean, Ohio, Daviess, and Morganfield landfills) to personnel shed, equipment maintenance, full-time attendant, and communication facilities (Owensboro, Henderson, Anaconda, John Collins, and Dyer Salvage landfills). The detailed soils map in the appendix shows the type of soil at these landfills.

ENTER
SLOWLY

Scales with a Recycled Caboose at Henderson City Landfill

Except for the landfills in Ohio County and the City of Morganfield, all others have sufficient area to handle the waste in the future from a countywide waste collection system.

The Ohio County Landfill District, Inc., is in the process of starting a new landfill in the northern part of the county near the Daviess County border. This proposed landfill (30 acres) will service all of Ohio County and nearby areas. It also has a potential for expanding an extra 30-40 acres if required to serve as a regional landfill in the future.

The City of Morganfield landfill has a life of approximately three years. This being the only permitted disposal site in Union County, there is a need for a new large landfill. The City of Morganfield has considered about 100-150 acres of land near the city airport. This will be sufficient for a countywide disposal site. This site will require careful analysis due to FAA regulations concerning location of landfills near airports.

During our ongoing monthly field survey of these landfills, we have noticed improvements in the operations. At present, nine out of ten landfills are permitted by the State Division of Solid Waste. One permit was denied because of the lack of a fence. The county has already started taking steps toward correcting this situation.

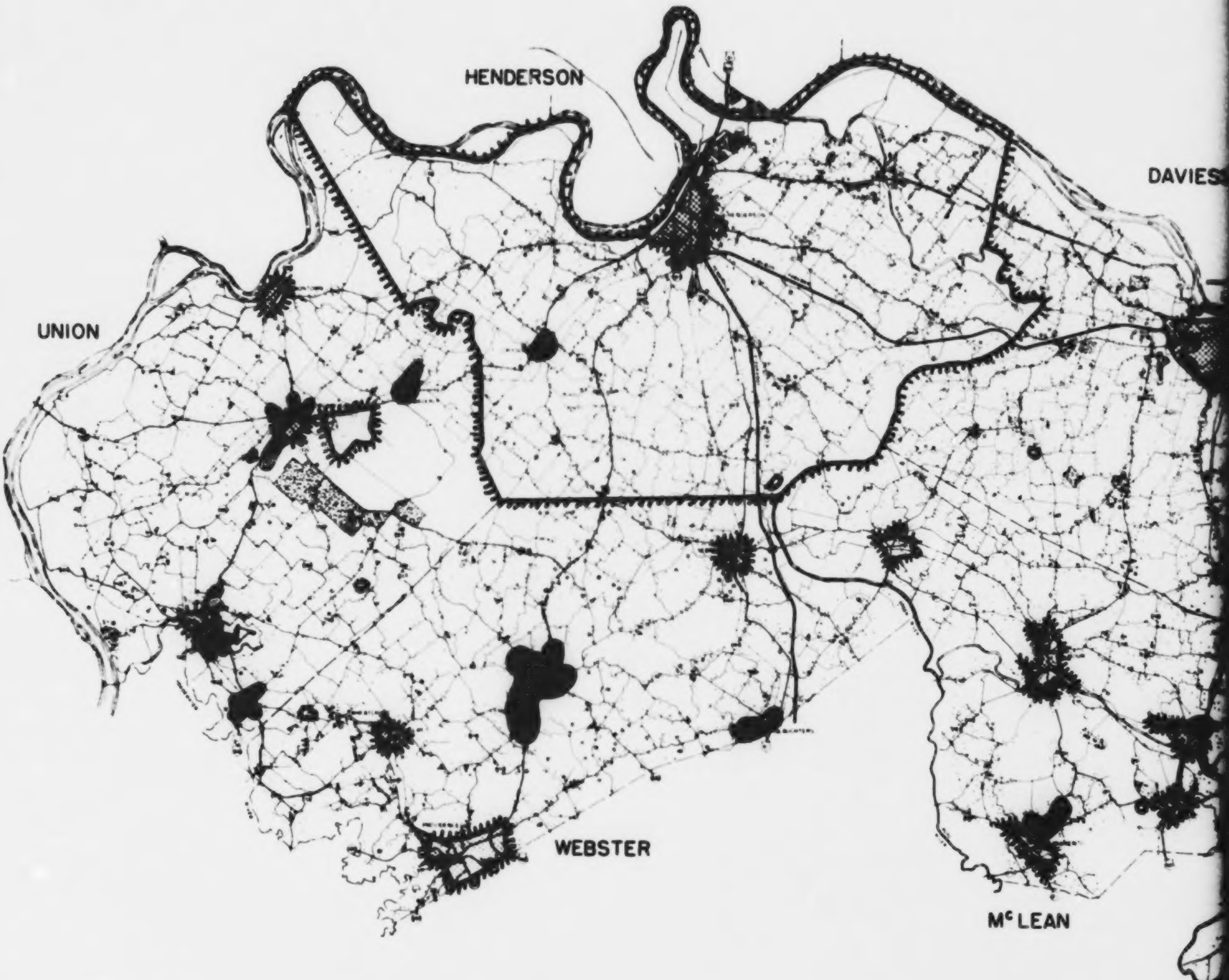
It is difficult to locate and list all of the illegal dumps in the area. But it is being recommened in this report that, as soon as a countywide collection system comes into existence, help from local governments, Chambers of Commerce, the State Division of Solid Waste, county health departments, and area citizens will be organized to eliminate and discontinue open dumping and open burning of solid waste. This process of closing open dumps must follow a planned program to eliminate rodent and other hazards.

TABLE 7

EXISTING LANDFILL SURVEY

NAME	OPERATOR	LOCATION	SERVICE AREA	SIZE ACRES	VOLUME/DAY TONS/DAY (Estimate)	EQUIPMENT	OPERATING PERMIT	DISPOSAL CHARGE
1. Hancock County Landfill	Hancock County Disposal District	5 miles west of Hawesville on Old Hawesville Owensboro Road	Hancock County	5	3-5	1 crawler dozer	Yes	Pick Up $2.00 1 ton truck 5.00 2 ton truck 10.00
2. West Daviess County Landfill	Daviess County Fiscal Court	Near West Louisville, off KY 815	Daviess County	15	5	1 crawler dozer	No	Pick Up 1.00 1 ton truck 2.50 Packer 5.00
3. Owensboro City Landfill	City of Owensboro	6 miles south of city on Hills Bridge Road	City of Owensboro	200	200	2 crawler dozers 1 crawler loader 2 rubber-tire loaders 1 scraper	Yes	Minimum 1.00 Pick up 2.00 1½ ton truck 3.00 1½ ton truck with sides 5.00 18 cu. yd. packer 10.00 30 cu. yd. trailer 15.00
4. Dyer Salvage Landfill	Dyer Salvage Co. Owensboro	10 miles northeast of Owensboro on Kelly Cemetery Road	Private and industrial customers (Material recovery operations)	10	10	1 crawler loader 1 crawler dozer	Yes	—[1]
5. Henderson City Landfill	City of Henderson	North of Henderson on Stratman Road	City of Henderson, Henderson County	36	100	1 crawler dozer 1 compactor 1 rubber-tire loader 1 grader	Yes	$1.70 per ton[2] of waste

GREEN RIVER AREA DEVELOPMENT DISTRICT


HENDERSON
DAVIES
UNION
WEBSTER
McLEAN

EXISTING LAND USE

LEGEND

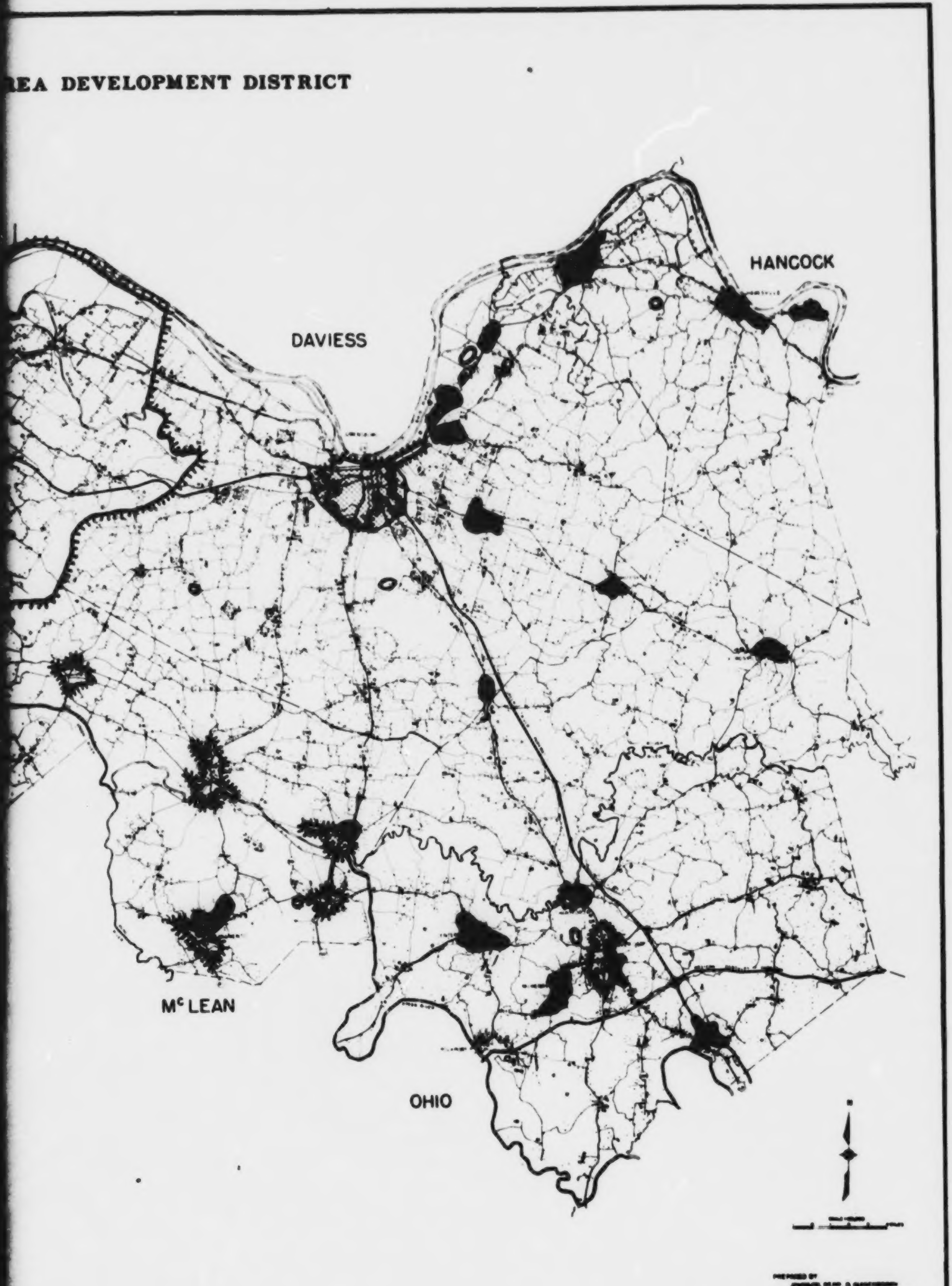
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
SCHOOL
CHURCH
CEMETERY
TRAILER PARK
RECREATION-OPEN SPACE
PUBLIC
SEWAGE TREATMENT
WATER TREATMENT
HIGH DENSITY AREAS

EXISTING SOLID WASTE COLLECTION & DISPOSAL SERVICE AREA

⚙ PUBLIC COLLECTION SERVICE

● PRIVATE COLLECTION SERVICE

○ DISPOSAL SITES


REA DEVELOPMENT DISTRICT

DAVIESS
HANCOCK
McLEAN
OHIO
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JOHNSON, DEPP, & QUISENBERRY
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FIGURE 7

TABLE 7

EXISTING LANDFILL SURVEY (Cont'd)

NAME	OPERATOR	LOCATION	SERVICE AREA	SIZE (Acres)	Volume/Day Tons/Day (Estimate)	EQUIPMENT	OPERATING PERMIT	DISPOSAL CHARGE
6. Anaconda Aluminum Landfill	Anaconda Aluminum Company	S.E. corner of Henderson County. East of Rock House Road	Anaconda Aluminum Company (Industrial landfill)	5	1-2	1 Crawler dozer	Yes	–
7. McLean County Landfill	McLean County Fiscal Court	Near Buttonsberry on Route 85	McLean County	10	3-5	1 crawler dozer	Yes	–[3]
8. Ohio County Landfill	Ohio County Landfill District, Inc.	3 miles west of Beaver Dam off Hwy. 273	Ohio County	20	40	1 crawler dozer	Yes	–[4]
9. Morganfield City Landfill	City of Morganfield	3 miles S.W. of City on county road linking Hwy. 130 and US Hwy. 60	Morganfield and Union County	20	5	1 crawler loader	Yes	Car $1.00 Pickup truck 2.00 Single axle truck 5.00 Tandem axle 10.00 Trailers 25.00
10. John B. Collins Landfill	John B. Collins	Ky. Hwy. 109 near Wheatcroft	Providence, Clay, Slaughters, Webster County, Sturgis, Uniontown, Union Co.	30	25	1 crawler dozer 1 crawler loader	Yes	Car .50 55 gal. drum 1.35 Pick up 1.50 Pick up w/sides 2.50 Single axle 3.50

1. Disposal charge varies with type of waste, no set charge.
2. The landfill is installed with a weighing scale.
3. Disposal operation is financed through county general fund. No charge to public for disposal.
4. Landfill is financed through fiscal court and donations from the industries. No disposal charge.

NOTE: The service area cited above is the prime service area. Some waste from nearby areas is brought to most fills.

SOURCE: **GRADD Solid Waste Survey.**

3. HOSPITAL WASTE

With the increasing practice of using disposable products of all kinds in the hospital, the disposal problem of hospital waste has become more difficult. According to recent statistics, the average American generates about 5.5 pounds of waste everyday. The average hospital patient, however, generates 25 pounds daily. This waste will reach about 35 pounds by 1980.

This District, with its six major hospitals with a capacity of about 930 beds, has an annual occupancy rate of 82 to 85 percent.

Hospital waste could fall under the category of hazardous waste, but is it comparatively easy to take care of with the proper handling and disposal techniques. Single-used medical supplies (syringes, surgical supplies, uniforms, etc.) and potentially infectious material from patient care and surgical wards comprise a major portion of waste along with kitchen and food processing waste. This stream of pathological, infectious, and chemical contaminants, ranging from human organs and tissues to mercury thermometers and surgical dressings, is often introduced to hospital disposal systems, namely an incinerator, or the community system, or both, without special treatment.

Ideally, these wastes should be sterilized, then incinerated, or should be transferred in a leak-proof non-littering container to the proper disposal sites. In this region, there is no practical way of segregating hospital waste into contaminated and uncontaminated waste; they are commingled together by the time they reach the storage area. Therefore, all waste from hospitals should be considered to be contaminated and should be treated cautiously.

Waste Handling Within the Hospital

The hospital survey of this region concluded that there are three methods of waste transport in the hospitals: by cart, gravity chute, or tightly packed plastic bags. Surgical waste, contaminated waste, and medical records are burned in gas-fired incinerators at most of the hospitals. (See Table No. 8) Hospitals in Daviess, Ohio, and Henderson counties have provided in-house waste handling training for their personnel through the hospitals, county health departments, or city sanitation departments. Others do not have any training for the handling of waste within the hospitals.

Waste Collection and Disposal

Apart from surgical and other contaminated wastes which end up in hospital incincerators, noncontaminated waste is collected daily and stored in containers or in the garbage storage room. The collected waste, in turn, is picked up by the respective city, county, or hospital personnel and taken to the disposal site. With the exception of Union and McLean county hospitals, where wastes are collected twice a week, wastes from all other hospitals are collected six days a week. The disposal sites used for such waste are the public landfills in each county. It is known that the mixing of such waste with other waste disposed of at the landfills requires a sanitary landfill operation.

Therefore, the collection and storage of such waste within the hospital should be exercised with the highest safety. Some of the recommendations for such handling are discussed below.

1. Pneumatic chutes using plastic bags should be installed for transporting waste. The air within this system can be continuously filtered, reducing the potentiality of infection.
2. Incinerators for surgical and pathogenic wastes should be operated efficiently with total combustion. Incinerators sometime fail to melt disposable syringes and needles which can cause injury to employees. They also can become clogged and block air intake or emission channels.
3. Compactors should not be used for discarding pathological waste matter unless this waste is sterilized or gets approval from the health authority. Compactors and shredders for hospital waste may create hazardous aerosol. If compaction is necessary, specially built compactors for such waste should be installed.
4. Sterilized pathological waste should be easily compacted, shredded, incinerated, or ground up for sewerage or safely disposed of with other waste at the landfill.
5. Though the land disposal is not a final answer for such waste, we believe that this method will be practical in this region, along with the inhouse incinerators, for years to come. Such waste disposed of at the landfill should be placed at a confined area and should be immediately compacted and covered daily without fail. Any scavenging in such areas should be strictly prohibited.

In short, reducing usage of disposable items and sterilization of such waste before storage and transportation can minimize all the potential hazards within the hospital and with the collection and disposal personnel. It is believed that the sanitary disposal methods for hospital wastes are an example of preventive medicine which all hospital personnel can practice.

TABLE 8

HOSPITAL SOLID WASTE IN GRADD

NAME OF HOSPITAL	COUNTY	NO. BEDS	Occupancy Rate	Amount of Refuse / Wk.	Collection Frequency	Collection Agency	Incinerator Type	Disposal Site	Waste Handling - Procedure
Union County Hospital	Morganfield, Union	54	65%	23 cu. yd. (10'x12' Trailer)	Twice/Wk.	City of Sturgis	Double burner gas (needles and contaminated waste)	City Dump	- None -
Ohio County Hospital	Hartford, Ohio	68	90%	25 cu. yd. (7'x12'x30' Rm)	6 Days/Wk.	Hospital Personnel	Paper burner 4'x3'x3' capacity	County Landfill	Through Health Dept.
Our Lady of Mercy Hospital	Owensboro, Daviess	133	70%	70 cu. yd. (12 cu. yd. Dumpster)	6 Days/Wk.	City of Owensboro	Gas fired 1 cu. yd. (payrolls and medical records)	City Landfill	Training
McLean County General Hospital	Calhoun, McLean	26	85%	12 cu. yd. (6-20 gal. can) (8'x9'x9' room)	Twice/Wk.	McLean County	Gas fired 1 cu. yd. (needles and contaminated waste)	County Landfill	- None -
Community Methodist Hospital	Henderson, Henderson	191	80%	126 cu. yd. (3-2 cu. yd. container) (canvas & carts)	6 Days/Wk.	City of Henderson	Gas fired	City Landfill	Yes By the Hospital
Owensboro-Daviess County Hospital	Owensboro, Daviess	458	87%	252 cu. yd. (3-12 cu. yd. container)	6 Days/Wk.	City of Owensboro	Gas burner 1 cu. yd. (needles isolation waste)	City Landfill	Yes, Health Dept., Hospital Joint Commission, Sanitation Dept.

4. INCINERATORS

Data was obtained on solid waste incinerators in the region. Unit capacity is available, but individual records are not kept by operators to indicate the amount of waste burned. However, we can conclude that a small but significant portion of the total waste load is disposed of by this method. Enforcement action by the state is eliminating many of the "burn barrels" behind small commercial establishments.

The establishment of a regional solid waste system would provide a reasonable alternative to the remaining unpermitted burning operations. The economics of resource recovery has affected the elimination of some burning operations. Some operators whose waste consists largely of corrugated packing materials have found it worthwhile to install a small compactor and sell their baled cardboard for recycling.

iv. proposed services

PROPOSED SERVICES

People in sparsely populated areas produce much the same kinds and quantities of wastes as their urban neighbors. Unfortunately, with decreasing population densities, scattered houses, and bad road conditions, the collection cost (mostly labor) becomes higher than most householders are willing to pay. More than half of the cities in the District have some form of waste collection system. However, the rural areas, except Henderson County, do not have any regular waste collection system except some scattered services offered by private collectors. With such scattered services involving no defined service boundary or system objectives, equipment and manpower have been wasted in the area, providing only 10-20 percent of the total needed service.

The lack of solid waste service has created numerous unnoticed roadside and community dumps that breed rodents, flies, and mosquitoes; cause fires and odors; create health hazards and water pollution; and blight the land. Recently, increasing public concern about these hazards has forced local governments to seek ways to eliminate the dumps and work towards an efficient solid waste management.

With the increasing amount of waste generation, growing technology of waste management, and strict state and federal regulations, solid waste planning at the city and county level has become a more complex and costly task. Because of these complexities, many local officials around the District are finding that a regional approach to planning and managing solid waste systems is the most suitable for their communities.

The regional approach in solid waste management means inter-governmental or inter-county operation. In this study, we strongly recommend inter-county operation—a seven-county solid waste collection and disposal system. This comprehensive solid waste plan for rural areas is prepared with two alternatives – a regionwide system and county-by-county system.

1. SYSTEM SELECTION

In selecting the type of collection system for the rural areas, the following criteria have been considered:

1. The system should serve sparsely populated rural areas and unincorporated cities.
2. The system should utilize existing rural road networks.
3. The system should be highly flexible in terms of routes, service area, and frequency of collection.
4. It should not require highly professional skilled labor.
5. It should be a uniform type of system for all the seven counties so that the equipment and labor could be interchangeable in case of emergency breakdown.
6. It should be economical in operation and long-lasting.
7. It should be flexible enough to service cities and incorporated towns in the future.
8. And last, it should be acceptable by the local government bodies and, most of all, by the citizens.

Different types of collection systems were considered to perform the job described above. Each system is briefly discussed below.

1. **House-To-House Collection:**
   Because of scattered houses and low population density in the rural areas, this system will require a large collection fleet. The operation cost in this system will require a service charge or revenue of $3.50 - $4.00 per house, per month.
2. **Mail Box Collection System:**
   This is the same system described above with modified curb collection. The refuse is put in a disposable container near the mail box on the rural route. The collection truck travels on the mail routes and collects refuse from the curb. For a rural area this system requires the same number of trucks and labor as the previous system. Although this system is more suitable for rural areas, there is not high enough population density in our District to make it feasible.
3. **Centralized Collection System:**
   In this system, the refuse is brought to centralized locations by the householders and then it is picked up along the centralized routes. This system eliminates the need of more routes, equipment, and labor in the previous systems. The types of refuse storage containers vary from small, front end loading containers to large stationary compactors, including roll-off containers, semi-trailers, and self-packing semi-trailers.

   The front end loading containerized system is more flexible, lower in capital and operation cost, and easier to maintain for small rural service areas. This sytem is described in detail in the latter part of this section. Major points against other systems include: (1) Considerable site preparation – a ramp, paved dumping area, concrete slab for container support, concrete retaining wall, fences, and separate access roads. This cost ranges from $7,500 - $20,000 per site against $100-$250 for site preparations for front end loading containers. (2) A power source is required for compaction on the site. (3) Frequently, large trailers for hauling cannot be used in the District because of weight limits on the rural roads and bridges. (4) Open body type, large containers are more susceptible to fire, fly, vector and other health hazards than regular small containers. (5) Each of these containers with its large capacity will serve substantially more houses than regular containers. The lower population density in the rural area will call for a large service area for each container, which increases the travel distance for the householders as long as six to seven miles or more, creating negative attitudes toward the acceptance of the system.

Thus, the only economical and simple choice for rural waste collection in the District is the front end loading container system.

2. COLLECTION SYSTEM DESIGN

The containerized collection system is proposed for the regional system and also for the county-by-county collection system.

The system is designed with the following steps: selection of equipment; determining number and size of equipment; selection and identification of container sites; selection of collection routes; and estimating capital and operating cost of the collection system.

The system will require containers, front end loading packer trucks, and pickup trucks for maintaining container sites and general operation.

In determining the size of the packer truck and the number of containers, the following criteria were used: the population to be served; waste generation rate for residential units (1.5 to 3.0 pounds per capita per day); waste volumes from commercial units; residential density (number units/ square mile); frequency of collection (once or twice a week); and the density of waste in the container (200-250 pounds per cubic yard).

The service area is divided into smaller zones and the number of containers required for each zone is calculated and adjusted according to the selected frequency of collection for that area.

The size of the collection truck - the front loading packer truck used in this system - varies from 24 to 34 cubic yards with 1:4 packing ratio. The truck can lift the container at each site, dump the waste in the packer body and put the container back on the site, and go to the next site. This whole operation is mechanical and could be handled by the driver. The time required at each site is about five minutes for the first container and two minutes for each additional container.

This truck could handle four, six, or eight cubic yard size front loading containers. Six cubic yard size containers of universal steel box body with side and top hinged-type doors are selected for this system. They are about 6-3/4 feet high, 6-1/2 feet wide, and 5 feet deep with a loading height of 3 feet.

30 cu. yd. Front End Loading Truck and 6 cu. yd. Container

Source: Dempster Brothers, Inc.

Though the smaller sized containers (4 cubic yard) are easier for the average housewife for dumping refuse, they will require more containers, extra container sites, and eventually high capital and operating costs. The larger container (8 cubic yard) is too tall for easy access. It will need comparatively fewer sites, making necessary longer trips for residents to haul their refuse for disposing.

This system will also need 2-ton truck(s) for site cleaning, maintenance, and handling unusually large objects.

3. FREQUENCY

Collection frequency could range from once a week to three times a week or higher. The advantages of higher frequency includes: (1) it is more acceptable to the general public, (2) spillage of trash and overloading of containers is minimized, (3) the overall system requires fewer containers, (4) requires smaller and lighter trucks and is suitable for the area where there is weight limitation due to bad roads and bridges, (5) reduces the health hazards from vectors and rodents and reduces the fly and insect breeding potential.

Limitations to this approach are the increased capital, operation, and maintenance cost as well as personnel. This is mainly because of the following factors: (1) more trucks will be required, (2) the routes would have to be redesigned to insure that the trucks are close to their capacity before they go to the disposal site, (3) more crews are required, (4) fuel and maintenance cost is increased because of longer routes and increased mileage, (5) with the increased frequency, waste load is increased, (6) the container site cleanup is required more frequently, (7) the waste load varies on the different days of collection. Normally it is high on the last day of collection which may cause overloading of the containers. The cost difference of the system is very sensitive to the increased load.

The proposed system is once-a-week collection for Hancock, Henderson, McLean, Union and Webster counties. Daviess County, with the largest population, has a very large volume of refuse generation which requires many truck trips to the landfill. This will require three or more collection trucks. Therefore, it is economical to provide twice-a-week collection in the county with two collection trucks. Ohio County, being largest in area, needs longer routes. The proposed landfill is in the northern part of the county, so the twice-a-week collection will serve these routes without additional trips to the landfill or requiring any additional trucks.

4. SELECTION OF CONTAINER LOCATIONS

The locations of the container sites have been selected to achieve convenience to the user and accessibility for servicing.

Ideally, each container site should be located at the center of the group of houses it will serve. Sometimes a site selected at a considerable distance from the group of houses may be desirable to take advantage of the householders' habits, such as going to the old dump site, buying groceries, etc. The potential container locations considered here include schools, parks and recreation areas, road intersections, litter barrel sites, churches, service stations, commercial areas, community centers, and old dump sites.

These sites have been selected in such a manner that about 65 to 70 percent of all the houses in the service are within one mile of the containers, 80 to 85 percent within two miles, and 90 to 95 percent within three miles of the container. The safety of the householders using such containers is as important as the selection of a proper site. A site survey was made in Union and Hancock counties to analyze the selected sites from the viewpoint of location and safety. These derived criteria were then used in designing the system for the region.

Safety factors analyzed before selecting a container site include: (1) sufficient area at the site to provide waste unloading, services and vehicle turnaround without causing any traffic hazards, (2) proper drainage of the area, all-weather surface at the site, (3) sufficient sight distance each way from the location to provide safe ingress and egress at the site.

Success of a containerized collection system is closely associated with the proper location of the sites. This could be accomplished by experimenting with site locations during the initial operation until it is accepted by the residents of the area. The proposed collection sites of this regional plan have been analyzed and reviewed in cooperation with the county fiscal courts, planning commission meetings, GRADD Solid Waste Steering Committee, and GRADD Board of Directors. The container locations are shown on the regional map and on individual county maps. (See appendix.)

5. SELECTION OF ROUTES

Selection of the initial route is primarily based on the road network in the county, number of containers to be serviced, size of the truck, frequency of collection, and time elapsed during the unloading of containers. Each route handles one truck load of refuse before going to the disposal site. The containers are assumed to be 90 percent full at the time of collection, and each route carries from 8 to 22 containers depending on the particular area. Each route can be handled by only the driver of the truck; no extra labor is required. Fewer sites and their locations on the roadside make the rural routing system more flexible, and any additional containers (at new subdivisions or participation of the city) can be easily absorbed in the route.

Normally, the time of collection and length of the route are the limitations in any waste collection system. The time required at each site is assumed to be five minutes to unload the first container and two minutes for any additional containers. The narrow roads of the rural counties and dangerous intersections limit the speed of the truck on the collection route. The average speed of the truck between the containers has been selected as 15 miles per hour and for the haul to the disposal site as 20 to 30 miles per hour. The productive time involved in each route includes the time of travel between the sites and the time of collection at each stop. The nonproductive time includes the time of travel from the garage to the route, time of travel from the route to the disposal site, the time of travel between the disposal site to the new route or to the garage and average time for unloading the refuse at the disposal site. Other time delays include lunch time, relief, unusual traffic conditions, fatigue time of the driver, picking up spills, difficulty in handling the container, exceptionally large and clumsy items placed in or outside the container, and downtime of the truck on the route.

In the regional system, the length of the route varies from 40 to 100 miles, and the time elapsed in serving these routes ranges from two and one-half to six hours. This information, along with the container locations, route designation, and schedule of operation, have been shown on the respective maps in the appendix.

Cleanup routes are recommended before starting the system to collect accumulated waste and heavy objects and also for residents to familiarize themselves with their route schedule. Also, radio communication is recommended between the garage and the truck to avoid time delays and extra trips. Normally, the first six months of operation will be used to collect the data of the route before the container collection and routes are stabilized. It is strongly recommended that a complete recording of the system is maintained to be helpful in updating and expanding of the system in the future. A sample recording form is shown in the appendix.

Each incorporated city in the District would continue door-to-door waste collection and would use its present disposal site. Those cities that do not have any collection service should either try to incorporate with the proposed regional individual county system or initiate the same type of service on their own.

All the cities should use regional disposal sites for waste disposal. It is strongly suggested that the cities should discourage new dump sites and eliminate existing dump areas.

GRADD staff would assist any unit of government in the region in organizing solid waste collection and disposal systems.

v. regional
solid waste system

REGIONAL SOLID WASTE SYSTEM

The majority of the local communities with or without collection systems are disposing of their solid waste outside their own borders in another community which has a handy landfill or a convenient dump. This creates intercommunity problems thereby promoting an uncertain future for their growing solid waste problem.

A regional approach will provide an optimum view of collection and disposal practices, a view that requires a broader regional perspective since public resistance to traditional irregular waste collection practices and poorly operated landfills can run high.

If each county operated its own system, the collection truck, landfill equipment, and employees would be idle most of the time except in the densely populated counties. If several counties used the same sanitary landfill, the purchase of redundant equipment and hiring of redundant employees could be avoided.

Because of the smaller size and lower population of the county, the collection truck would serve the area in two or three days. In the multicounty approach, the same truck would be able to serve more than one county, thus saving capital and operation cost. This is clearly evident in the section on the proposed system for the individual county (Figure 13).

Therefore, this plan recommends that several counties use the same collection truck and a single disposal site as shown in Table 9. The proposed disposal system is shown graphically in Figure 8.

TABLE 9

PROPOSED REGIONAL SOLID WASTE SERVICE

Waste Zone	Zone No. 1	Zone No. 2	Zone No. 3
Counties	Henderson Union Webster	West Daviess MClean West Ohio	East Daviess Hancock East Ohio
Rural Population	21,300	25,000	25,000
Waste Load from Residential and Commercial Area Tons/Year	5,110	6,570	6,570
Packer Truck (34 Cu. Yd.)	1	1	1
Containers (6 Cu. Yd.)	142	108	99
Regional Sanitary Landfills	1	1	1
Estimated* Size of Landfill (Acres)	60	75	75

* Estimated size of the landfill for 20 year life accounts for the waste load from the proposed landfill in addition to industrial and institutional waste in the rural area. It does not take care of the waste loan from incorporated cities or towns.

REGIONAL DISPOSAL SITES

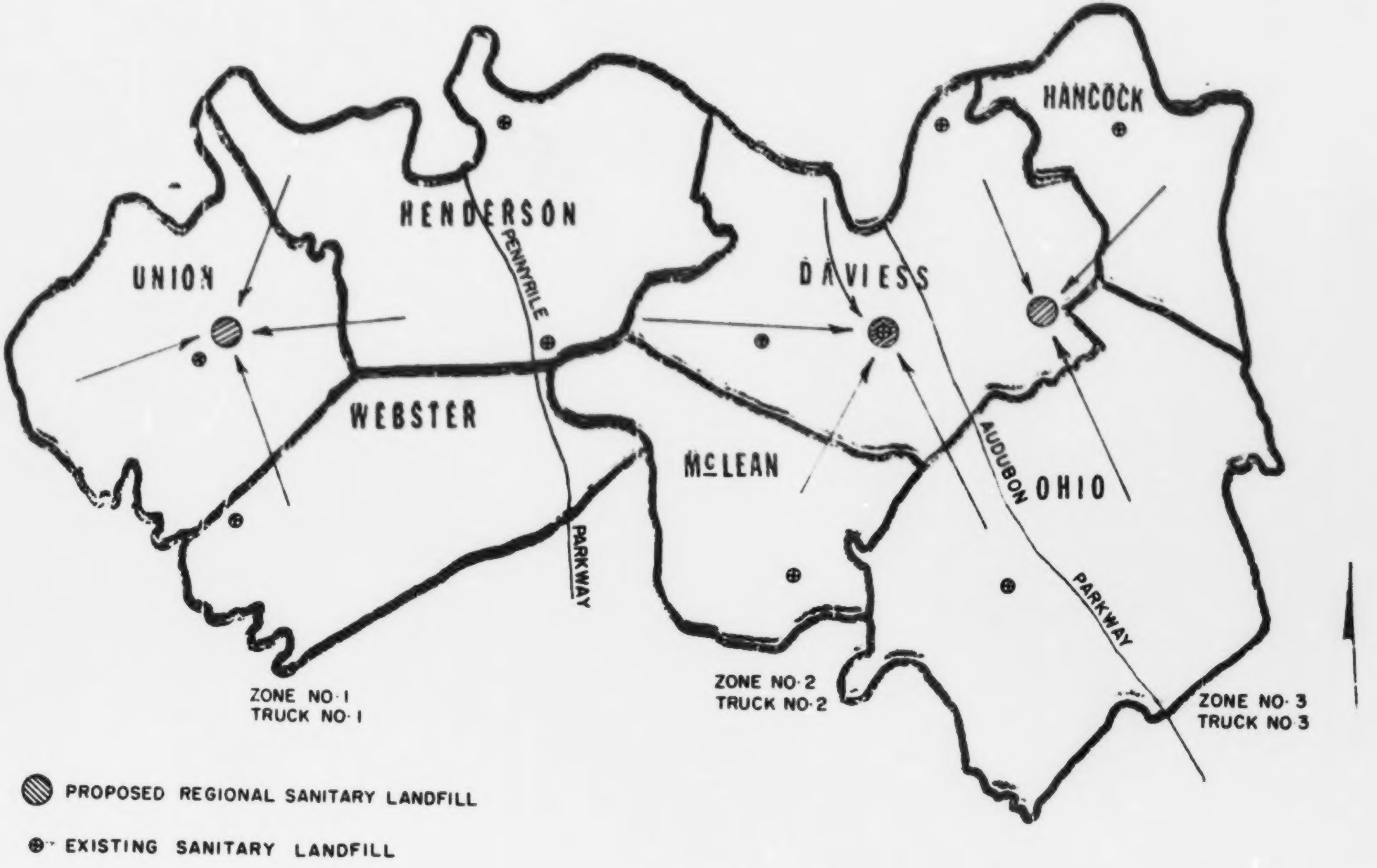
HANCOCK
HENDERSON
UNION
DAVIESS
WEBSTER
McLEAN
OHIO
PENNYRILE
PARKWAY
AUDUBON
PARKWAY
ZONE NO·1
TRUCK NO·1
ZONE NO·2
TRUCK NO·2
ZONE NO·3
TRUCK NO 3
▨ PROPOSED REGIONAL SANITARY LANDFILL
⊕ EXISTING SANITARY LANDFILL

FIGURE 8

GREEN RIVER
Area Development District

6 0 6 12 18
mile

1. COLLECTION

The District is divided into three different waste zones according to physical and topographical barriers as shown in Figure 8 and Table 9.

Collection frequency is selected in each area depending on the waste load, road conditions, area of service, and length of the route to fit in the total service. The routes in the counties of Daviess and Ohio will be serviced two times a week, and the rest of the counties once a week.

Each zone is to be serviced with one 34 cubic yard front loading packer truck working eight hours a day for six days a week. Major routes are from four to six hours a day, with the remaining time to be spent for daily truck checkup and maintenance.

The locations of container sites, routes, and service areas are shown on the regional map in the appendix. Three front loading trucks can service the whole collection system of 349 six cubic yard containers in a weekly operation. Additional trucks are recommended for backup and emergency operations. This would also relieve other trucks for periodic maintenance.

Table 10 shows regional collection route data with container site location numbers, length of the route, and collection time.

For cleaning and maintaining the containers in the system, portable steam cleaners and paint sprayers are recommended. Radio communication between the trucks and garage is suggested in the system to avoid time delays and to handle emergency situations.

A qualified system manager will be coordinating the collection operations between the truck drivers and the pickup truck crewmen for efficient operations. Equipment and personnel recommended are shown in Table 11.

It is difficult to recommend definite administrative and management locations for the system; therefore, it is tentatively proposed that garage facilities be located at the disposal sites. A single regional garage is a possible alternative.

Table 12 shows the complete collection cost for the proposed regional system. The cost figures shown reflect the present unit cost and should be upgraded according to the price index of the first year of operation. Note that the cost figures include 360 containers instead of 349 as recommended by design. The additional containers would be used for any emergency need at the same site and also at the entrance of the landfill for Sunday and off-hour waste disposal for the residents.

It is suggested that the packer truck drivers be responsible for their routes. They will act as supervisors and be directly responsible for reporting any change of container sites, overloading, or road trouble to the system manager.

The different alternatives for financing the capital and operating cost of this system are outlined in the section on financing. The operation cost could be collected as a service charge, or a percent charge of each user's property tax, or from each participating county based on the percentage of total ton-miles share for that county. The ton-miles charge seems the most practical since the total collection cost is more dependent on how many miles the truck has to travel and the labor involved there to collect waste from the containers.

TABLE 10

REGIONAL COLLECTION ROUTE DATA

TRUCK NO. 1

Route Identification No. (1)	No. of Cont. (2)	Cont. Site Location No. (From-To) (3)	Uncompacted Waste Vol. (Cu. Yd.) (4)	Length of Route (Miles) (5)	Time Hrs. (6)
M-1-A	13	1 - 13	62	38	2.50
M-1-B	22	14 - 35	106	53	4.50
T-1	20	36 - 55	96	60	4.00
W-1	22	56 - 77	106	105	6.00
Th-1	23	78 - 100	110	100	6.00
F-1	19	101 - 119	91	85	5.00
S-1	23	120 - 142	110	100	6.00
TOTAL	142	1 - 142 (142)	681	541	34.00

TABLE 10

REGIONAL COLLECTION ROUTE DATE (Cont'd)

		TRUCK NO. 2			
M-2-A	21	143 - 163	100	70	4.50
M-2-B	15	164-174, 247-250	72	20	2.00
T-2-A	10	175 - 184	48	20	2.00
T-2-B	19	185 - 203	91	72	4.50
W-2	21	226 - 246	100	100	6.00
Th-2-A	21	143 - 163	100	70	4.50
Th-2-B	15	164-174, 247-250	72	20	2.00
F-2-A	10	175 - 184	48	20	2.00
F-2-B	22	204 - 225	106	72	4.50
S-2	21	226 - 246	100	100	6.00
TOTAL	175	143 - 250 (108)	837	564	38.00

TRUCK NO. 3

Route Identification No. (1)	No. of Cont. (2)	Cont. Site Location No. From - To (3)	Uncompacted Waste Vol. (Cu. Yds.) (4)	Length of Route (Miles) (5)	Time Hours (6)
M-3-A	8	251 - 258	38	24	1.50
M-3-B	17	259 - 275	82	36	3.00
M-3-C	9	276 - 284	43	45	2.50
T-3-A	11	285 - 295	53	40	2.50
T-3-B	16	296 - 311	77	55	3.50
W-3	22	312 - 333	106	100	6.00
Th-3-A	8	251 - 258	38	24	1.60
Th-3-B	17	259 - 275	82	36	3.00
Th-3-C	9	276 - 284	43	45	2.50
F-3-A	11	285 - 295	53	40	2.50
F-3-B	16	334 - 349	77	55	3.50
S-3	22	312 - 333	106	100	6.00
TOTAL	166	251 - 349 (99)	798	600	38.00
GRAND TOTAL	483	1 - 349 (349)	2,316	1,705	110.00

NOTES:

Col. 1 – Route identification code as shown on the map in appendix. M-1-B. Second route on Monday of Truck No. 1.

Col. 3 – The site location number are for identification as shown on the map. The route does not necessarily follow the sequence of numbers. The figure in the parentheses shows total number of container locations to be serviced. **Note** this number varies from that of Col. 2 for trucks No. 2 and 3. This is because of two times a week routes in Daviess and Ohio Counties. Also, note the difference in grand total figures in columns No. 2 and 3.

Col. 4 – Container fullness at the time of collection assumed to be 80 percent.

Col. 5 – Mileage includes travel distance to and from the landfill.

Col. 6 – Total route time includes disposal time.

TABLE 11

EQUIPMENT AND PERSONNEL

Requirements for Regional System

EQUIPMENT				PERSONNEL	
TYPE	**SIZE**	**NO.**	**EXP. LIFE (Years)**	**TYPE**	**NO.**
Front End Loader	34 cu. yd.	4	5	System Manager	1
Containers	6 cu. yd.	360	10	Drivers	7
Portable Steam Cleaner	- -	2	10	Crewmen	6
Portable Paint Stripper	- -	2	10	Secretary	1
Pickup Truck	2 ton	3	5	Bookkeeper	1

TABLE 12

COLLECTION COST

CAPITAL COST Item	Size (Cu. Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly* Cost
Front Loading Packer Truck	34	5	4	$35,000	$140,000	$34,146
Containers	6	10	360	450	162,000	23,063
Portable Steam Cleaners	--	10	2	1,500	3,000	428
Portable Paint Sprayer	--	10	2	3,000	6,000	856
Pickup Truck	2 ton	5	3	5,000	15,000	3,657
Radio Communication						
Base Station	--	10	1	1,000	1,000	142
Unit	--	10	4	400	1,600	227
TOTAL CAPITAL COST					$328,600	$62,519

TABLE 12 - (Cont'd)

OPERATION COST

Salaries:

1 System Manager @ $10,000	$10,000
3 Drivers/Supervisors @ $6,500	19,500
4 Drivers/Helpers @ $6,000	24,000
6 Crewman @ $5,500	33,000
1 Secretary @ $4,000	4,000
1 Bookkeeper @ $6,000	6,000
TOTAL	$96,500

Administrative and Maintenance Cost:

Fuel and maintenance	$40,000
Administrative Contingency 20%	31,730
TOTAL	$71,730

TOTAL OPERATING COST	$168,230
TOTAL YEARLY COST	230,749

*Yearly cost includes depreciation and 7% interest cost.

2. DISPOSAL

The proposed regional disposal systemuses sanitary landfills. As shown in Figure 8, three landfills are proposed. Of these, one landfill owned by the City of Owensboro is already in operation and it is the best operated landfill in the District.

The other landfill sites selected from the waste load analysis are fortunately near the locations selected for the landfill by the local government. Proposed Landfill No. 1 site east of Morganfield is owned by the City of Morganfield. This site is near the city airport, so FAA regulations must be met before starting the operation. Proposed landfill No. 2 site is in the southeastern part of Daviess County near Whitesville. Ohio County has already selected a county landfill site about two or three miles south of the proposed regional landfill.

Table 13 shows the description of the landfills and their respective service area. The proposed landfill size and cover requirements are calculated for 20 years of proposed regional waste collection load.

Since this plan recommends developing these landfills as regional disposal sites in the GRADD, it is suggested that the incorporated cities in the District should also use these landfills as their disposal sites.

The plan strongly suggests initiation of a first-class operation at these sites to meet state and federal standards. Maximum facilities should be provided at the landfill, which include adequate equipment, personnel shelter and equipment shed, water and sanitary facilities, and radio communications.

Table 14 shows equipment and personnel needs. The ownership of these sites depends on the management decision of the complete regional system. The cost figures shown in the table are for the minimum needs of a typical landfill of the recommended size. Note that these cost figures are 1974 estimates.

TABLE 13

REGIONAL WASTE DISPOSAL

PROPOSED LANDFILL	SITE NO. 1 (L.F. - 1)	SITE NO. 2 (L.F. -2)	SITE NO. 3 (L.F. - 3)
COUNTIES	Henderson Union Webster	West Daviess McLean West Ohio	East Daviess Hancock East Ohio
RURAL POPULATION	21,300	25,000	25,000
COMMERCIAL UNITS	143	142	110
WASTE LOAD (Tons/Year)	5,100	6,570	6,570
ESTIMATED AREA OF LAND required for 20 years of landfill life (600 lb./cu. yd. compaction and 12-15 ft. depth) (Acres)	60	75	75
ESTIMATED AMOUNT OF SOIL required for cover for 20 years landfill life (Acre ft.)	150	200	200
AVAILABILITY OF COVER MATERIAL AT THE SITE	Sufficient	Sufficient	Sufficient
METHOD OF PROPOSED LANDFILL OPERATION	Trench	Area	Ramp/Slope
REMARKS	1. Near airport. Requires FAA regulation. 2. Site is 100-150 acres. Sufficient to handle waste from cities.	1. Surface discharge. Pond required. 2. Presently good operation. Site is 200 acres. Can easily handle waste from cities.	1. Extensive site preparation required. 2. The site is in design and planning stage. Could handle waste from the cities.

TABLE 14

LANDFILL COST

FOR EACH REGIONAL LANDFILL

CAPITAL COST

Item	Life (Years)	Total Cost	Yearly Cost*
Bulldozer	8	$42,000	$ 7,014
Wheel Tractor Scraper	8	30,000	5,010
Scales	20	8,000	752
Shelter	10	6,000	852
Fence	10	1,000	140
Radio Communication System	10	500	70
Site Preparation	5	1,000	244
Access Road	5	5,000	1,220
Total Capital Cost		$93,500	$15,302

OPERATING COST

Dozer Operation (4-5 hrs./day, 6 day/week, $2.75/hour)	$ 3,861
Scraper Operation (1 hour/day, 5 day/week, $2.00/hour)	520
Scale Operator ($500/month plus 5.2% FICA)	6,312
Dozer Operator ($550/month plus 5.2% FICA)	6,943
Landfill Manager/Operator ($600/month plus 5.2% FICA)	7,575
TOTAL Operating Cost	25,211
Total Yearly Landfill Cost	$40,513

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*Yearly cost includes depreciation and 7% interest cost

A complete record of day-to-day operations (as shown in the appendix) should be maintained by the landfill manager for present and future improvements of the site.

The disposal costs to be incurred by each landfill depend on the administrative structure of the regional system and landfill ownership. This could be based either on the total tons/year of waste load, or population of the county, or a fixed amount per year. See the financial section for other alternatives of system financing.

In this age of resource conservation, a resource recovery potential should be evaluated. This is analyzed in the resource recovery section. The proposed regional landfills will play a greater role in this direction. With the greater concentration of the waste at these sites, they could serve as transfer stations to develop material recovery, energy recovery, or a combination of such techniques.

Typical Landfill Operation

Source Caterpillar Tractor Company

vi. management

MANAGEMENT

One of the most frequent questions heard is, "Should solid waste operation be public or private?" Both types can be successful. Both are operating satisfactorily in the region. One attractive solution on a regional basis is the formation of an areawide management authority. This authority could then contract with private operators for various franchise areas. While this design is primarily aimed at the thinly populated rural areas, cities could elect to have the management authority operate their solid waste utilities.

Every management authority will need to consider the following areas of activity: records, personnel, safety, financial, and legal alternatives.

1. RECORDS

Records are an essential management tool. Regardless of the size of the operation, records will alert the manager to critical areas which need attention. Records for a solid waste management authority fall into four broad classifications: (1) Personnel; (2) Equipment; (3) Waste load; (4) Financial.

Personnel records include employment forms, medical and safety history, wages, hours, management evaluations, and promotions.

Equipment records must include purchase data, daily use, and servicing information. Armed with this information, the manager will be able to decide what equipment is the best value. Scheduled maintenance records will often spot problems before they become critical.

Waste load data is easily obtained when scales are installed at the transfer stations and landfill. If this is impossible, then volume records must be kept. With this information, the manager will be able to detect inefficient routes. After corrections are instituted, he will be able to measure the improvement. Trends will be spotted through careful analysis of these records.

Financial records should be developed in consultation with a professional accountant. All costs and income must be accounted for in order to give a true picture of the entire operation. A well-designed accounting system will indicate where costs are high and often give an indication of the cause. On the income side of the record, good accounting insures fair charges.

2. PERSONNEL

Solid waste has traditionally been the lowest rung on the personnel ladder. Unfortunately, the "garbage man" has tended to remain at the lowest rung. There has been little upward mobility and very little transfer to other branches of the operation. Safety is notoriously bad in the solid waste services. All of these factors result in low productivity, poor morale, and rapid employee turnover. A key element in upgrading solid waste positions is job safety. Federal and State Occupational Safety and Health regulations make this mandatory now.

Local government studies in the GRADD confirm the impression of one official that "our solid waste people are always moving. They work hard." True. But working on poorly designed routes, with equipment changed little in over 30 years, they are not as productive as they could be.

The following recommendations may assist development of a more efficient personnel operation. (Note: Many recommendations presume a multi-employee operation. The inefficiency of a multitude of small solid waste operations without professional direction argues for combination of operations.) Establish civil service for solid waste personnel where this is not already done. Provide training, including safety practices. Encourage upward mobility within the solid waste operation. Provide opportunity for transfer to other departments. Provide safety equipment, such as hard hats, safety glasses, gloves, and safety shoes. Provide uniforms which insure adequate visibility. Provide written employee policy statements. Provide locker and shower facilities. Encourage adult education classes to qualify for promotion and transfer. Provide first aid equipment and training for each crew and work location. Analyze accident reports to identify trouble spots or unsafe practices. Encourage employee suggestions.

Productivity of solid waste employees varies greatly. One survey indicates differences of 500 percent in collection performance in different cities.[1] Lack of accurate weight volume data made direct comparison difficult. Consumer cost varied from $2.00 per month for twice-weekly collection to $4.00 for once-weekly service in one area of the District.

A full record system, discussed above, would provide the following measures of collection crew productivity: tons collected per crew collection hour; households served per crew collection hour; cost per ton collected; cost per stop; number of people served per truck per week.

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(1) The National Commission on Productivity. **Improving Productivity in Solid Waste Collection**, Washington, 1974 p. 1.

TABLE 15

SAMPLE CHECKLIST FOR REGIONAL MANAGEMENT

Authority - structure alternatives
Fair charges - ton, ton/mile or household charge
Legal authority - KRS 109 (Interlocal cooperating KRS 65)
Staff-employment policy
Billing
Office

Funding - Local property tax
Service charge
General fund
Combination
Bond
Alternative funds, e.g., Revenue Sharing

3. SAFETY

According to the National Safety Council, refuse collection and disposal is the most hazardous occupation in the United States. This occupation suffers 10 to 15 times as many injuries as the average worker in American industry.

Refuse collection and disposal is the most hazardous municipal occupation. Solid waste collection has an injury frequency rate of 99. Refuse disposal is close behind with a rate of 79. Firemen and police have safer jobs, with rates of 59 and 43 respectively.[2] Refuse collection, according to the same source, is also more dangerous than the so-called hazardous occupations of mining and logging.

This occupation also leads in the number of days lost from work. About six times more days are lost from work in refuse collection and disposal than all other occupations combined. Little has been done to correct this problem and evidently there is a lack of awareness of the problem. Each year, millions of dollars are spent for workmen's compensation benefits for solid waste related injuries.

The Environmental Protection Agency has developed a safety program for the solid waste collection industry. "Project Responsible," as it is called, provides a comprehensive audio-visual training program focused on safe working practices. Both management and employees are involved in this safety training program. Additional information on this safety program is available from the Kentucky Department for Natural Resources and Environmental Protection, Division of Solid Waste.

The solid waste industry is aware of the problem. Working with other groups, the National Solid Waste Management Association is developing safety standards for collection vehicles and stationary compactors. Safe equipment design should reduce the number of shearing, crushing injuries associated with solid waste collection. Disposal equipment modifications include roll-over protective structures (ROPS) which surround the operator with a steel cage. These safety standards should be included in bid specifications for solid waste equipment.

Basic elements of a sound accident prevention program include: (1) management safety goals; (2) regular maintenance of equipment; (3) safety training sessions; (4) accident reporting, recording, and analysis; (5) adequate first aid training and supplies; (6) employee safety motivation; (7) safe working conditions.

Personal responsibility for safety is the main controlling factor for an accident-preventive program. Only 10 percent of all accidents are the result of a "machine" failure. Almost all other accidents are the direct result of unsafe acts committed by the employee. Management may assign responsibility for safe acts to the employees, but by the same token there must be management involvement and constant evaluation of the program. Incentives play a great role. Employee incentives, such as wage increases or awards, help create personal safety responsibility among employees.

A. OCCUPATIONAL SAFETY AND HEALTH

Kentucky has adopted the Federal Occupational Safety and Health Act of 1970 (Williams-Steiger Act). The Kentucky law is extended to cover public employment as well as private employment. Another major change is that Kentucky has a stronger hard hat regulation than the Federal law. This law requires accurate records of death, injuries and illness.

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(2) National Safety Council **Work Injury Rates** (1972 Edition)

Two separate OSHA operations are provided in Kentucky. One is the Division of Compliance, the enforcement operation. The second operation is the Division of Education, Training and Consultation. Both are located in the Capital Plaza Tower, Frankfort, Kentucky. Their toll-free Hot-Line number is 1-800-372-2967

The following safety checklist is not complete. It is offered merely as a suggestion of the type of questions solid waste management should be asking about their operations: (1) Is a physician-approved first aid kit available for all employees? (2) Are there enough fully trained first-aid workers? (3) Are work areas clear and clean? (4) Are work areas well lighted? (5) Are walkways safe and non-slippery? (6) Are fire extinguishers provided wherever there is a possibility of fire? (7) Is communication equipment (radio, telephone, etc.) provided at landfill and other locations where emergencies may arise? (8) Are hard hats provided for employees on construction sites (landfill) and where falling objects may injure employees? (9) Are safety shoes, gloves, and other safety equipment required? (10) Are injury and illness records analyzed to pin-point dangerous conditions? (11) Are employee safety training courses being conducted routinely? (12) Have equipment noise surveys been made? (13) Is hearing protection equipment required where there is excessive noise? (14) Is adequate safe drinking water provided? (15) Are adequate toilet facilities provided? (16) Are employee clean-up areas clean, adequate, and well maintained? (17) Is packer equipment and other dangerous equipment provided with guards and safety controls? (18) Are power tools properly guarded? (19) Is electrical equipment properly maintained? (20) Are back-up alarms provided on equipment? (21) Are roll-over protective structures (ROPS) installed and maintained on construction vehicles? (22) If not, why not?

OSHA programs place responsibility on both employer and employees for an adequate safety program. Both Kentucky OSHA training help and the Kentucky Department for Natural Resources and Environmental Protection.

During the course of this study, several thousand dollars worth of equipment were destroyed in fires at solid waste facilities in the Green River region. Most solid waste burns readily. Training courses and proper equipment can reduce the property loss and danger to employees.

Adequate communication facilities are important. This is especially true in remote locations, such as landfills. Radio dispatch equipment in collection vehicles can reduce response time in case of fire or personal injury accident.

Local solid waste management officers can obtain assistance in developing a safety program from the State Department for Natural Resources and Environmental Protection, Division of Solid Waste. Other sources include the Occupational Safety and Health Program in the State Department of Labor, National Safety Council, American Public Works Association, and trade associations in the solid waste industry.

Insurance sources, and in particular the carrier of workmen's compensation for the unit of government, have technical staffs and safety material to develop a comprehensive safety program.

4. DISPOSAL SITE SELECTION

"Let's put the dump out in the sticks away from everybody." "Find the cheapest land possible for a dump." "Not in my neighborhood you don't."

You will not hear these conservations in the future. Disposal site selection is a scientific process. Not every site is suitable. This section is an overview of basic site selection considerations. Skilled technical assistance is required for final site location. This advice is available from governmental agencies (such as Kentucky Geological Survey, U.S. Department of Agriculture, Soil Conservation Service, Kentucky Department for Natural Resources and Environmental Protection, and local health departments.) Other engineering and consulting advice may be required, depending on the staff capabilities of the applicant.

All solid waste processing will require some land disposal. Incineration or composting will reduce but not eliminate the ultimate residue.

The first consideration should be haul distance. A landfill located near the population centers reduces unnecessary costs for waste transportation.

Land costs are only a minor consideration. When the landfill is located far from the population center, haul costs increase greatly.

The usual objection to locating a landfill near a population center is nuisance. This objection was valid when the open burning dump meant smoke, odor, and vermin. A modern well-operated sanitary landfill is clean, attractive, and odor-free. A highlight of a tour of solid waste facilities during this project was lunch at a landfill. Tour members enjoyed a pleasant lunch only a few hundred yards from the operating face of the landfill.

An engineering analysis of potential landfill sites should include a geological assessment. Natural features to be considered include topography, hydrology, type of bedrock, depth of bedrock, and soil conditions.

The GRADD covers the northern portion of the Western Kentucky Coal Field. Bedrock near the surface generally includes shale, sandstone, thin limestone, and coal.

Alluvial material covers the bedrock, particularly along the major rivers. This alluvium consists of sand, gravel, clay, and silt, to depths up to 140 feet. In the uplands, wind blown silt (loess) predominates.

Protection of ground water supplies is essential in landfill site selection. This means the site must be located well above aquifers. The base of the landfill must be relatively impermeable to provide a barrier between the compacted waste and the aquifer. Cover material and slope should encourage runoff. This reduces the amount of water which would percolate through the landfill. A seasonal high water table could present difficulties. Flood-prone areas are not satisfactory.

Soil must be deep enough to provide adequate cover. It should be workable, compactable, and free of cracks when dry. The final cover should be able to support vegetation.

General planning consideration for soils include (1) sand and gravel - coarse and permeable, not suitable. Generally these soils are found in flood-plain areas which are not suitable for landfill; (2) clay, generally a good bottom sealer, but as a cover material, it may be difficult to work in wet weather. Dry-cracking may be a problem; (3) wind blown silt (loess) - generally satisfactory.

Specific site soils analysis must be performed as a requirement for a state landfill permit. Detailed information on soils and geology of the area are available in the GRADD office. A map of general areas suitable for landfill is included. (See Appendix)

Mineral extraction has been a part of the economic picture of the GRADD region for many years. This presents both problems and opportunities for solid waste activities. Sites which include abandoned underground mines, oil or gas wells should not be considered. These mines and wells may provide channels for landfill leachate to flow into subsurface water supplies. Areas which have potential for mineral recovery (mines or wells) generally are poor candidates for landfill placement.

Surface mined sites are common throughout the district. Many such sites are "orphan" mines, that is, they were mined prior to Kentucky's reclamation law. Some of these open scars are potential landfill sites. "Orphan" sites have been used successfully as landfills in this region. The land is usually inexpensive, and adequate cover material is available. If the landfill is properly designed and operated, effective land reclamation will be the result. Useless strip pits can become golf courses, pasture land, or parks.

Abandoned strip mines are usually located at some distance from population centers. The resultant higher haul costs must be balanced against lower land costs and reclamation benefits.

5. THE PRIVATE SECTOR

Private involvement in the solid waste stream has been highly selective within the region. Industry is recycling their high value waste. Examples are wood chips sold to paper producers and metallic scrap sold to salvage operations or direct to users such as steel mills. Salvage specialists have concentrated on metallic waste. To date, almost all recycled waste was provided to the salvage operator as relatively clean scrap. There has not been any significant separation of valuable materials already mixed in the waste stream.

The private sector's interest in collection has mainly been the growing urbanizing fringe around larger cities. These areas are not being provided with municipal refuse collection. There is sufficient population concentration to justify the necessary investment and assure an adequate return. Some small cities have a franchise private collection operation. Some specialized private collection routes have been identified. These include animal by-products for rendering, spent motor oil, and specialized chemicals. Only two of the region's landfills are privately operated.

Planners can assume that growth will occur in private activity in the solid waste field. National solid waste-oriented corporations are experiencing rapid growth. A major reason for this growth is the strong management of these organization. A modern successful solid waste company uses every available management tool. Smaller operators, both public and private, must adopt a strong management strategy to remain competitive.

6. FRANCHISE

There are few existing franchises in the region. A few cities have a franchise arrangement. Most refuse operators collect without benefit of any written arrangement with the local unit of government.

In future development of solid waste systems, serious consideration should be given to the potential for franchising with private operators.

The advantages are that the local unit of government does not need to concern itself with day-to-day operational problems. A fixed predictable cost is pre-determined.

The chief disadvantage is reduced control of operations by the local unit of government.

Total cost for franchise vs. governmental operation cannot be determined until bids are received. Decision makers should be aware of hidden costs in choosing between franchise and governmental operations. For example, vehicle maintenance costs are sometimes lumped into the county/city garage budget. If these hidden costs are overlooked, the franchise bid might seem unattractive.

Private contractors can bring management expertise and economy of scale in their operations. Contractors presently operating in an area should be consulted in developing plans for an area. Their knowledge of existing practices, problems and opportunities will be valuable in developing workable projects.

TABLE 16

SAMPLE CHECKLIST FOR FRANCHISE PRIVATE COLLECTION SERVICE

Previous experience
Management skills and adequate staff
Adequate equipment, in detail, maintenance
Backup provision for equipment breakdown
Financial backing, performance bond
Detail list of collection responsibilities
What refuse must be collected as part of contract (No. of containers etc.)
Any special charges for bulky or unusual items, e.g. leaves
Environmental collection considerations, noise, odor, leaking, blowing controls, clean-up at curbside
Fee collection responsibility, government or contractor
Environmental transfer consideration
Ownership of transfer stations
Encourage resource recovery, (Who gets profit?)
Disposal (also collection and transfer) to comply with all existing laws
Disposal only at state approved landfill
Who pays disposal charges?
Exclusive or non-exclusive?
Special waste (tree trimmings, leaves, white goods, junk autos, demolition waste)
Responsibility for OSHA, insurance, etc., to be franchised
Records and reports
Ownership of waste - at what point?
Liability
Transfer points

TABLE 17

SAMPLE CHECKLIST FOR FRANCHISE – RECYCLING DISPOSAL – SERVICE

Meet state specifications
Approved landfill - state
Meets zoning and other legal restrictions
Ownership of waste
OSHA – Occupational, Health, liability, unemployment insurance
Performance bond
Records and reports
Billing
Facilities for residents, non-residents - commercial
Equipment - Backup
Personnel - Management.
Special waste handling

TABLE 18
SAMPLE CHECKLIST FOR BID –
COLLECTION SERVICE VEHICLE

Vehicle

- Packer
- Front load
- Truck chassis
- Engine
- Transmission
- Tires and wheels
- Capacity
- Packing strength
- Lights
- Container material and strength
- Safety standards Industrial and OSHA
- Manufacturing experience

7. LEGAL

The law of Kentucky provides a variety of mechanisms for solid waste activity by units of government. Individual units of government can "go it alone" with general revenues. Joint cooperation is possible with contracts as specified in the Interlocal Cooperation Act.

However, when the need for additional tax revenue appears, there is the temptation to form a special district. A special district should be used only as a last resort. All other possibilities of funding should be thoroughly explored before a special district is organized.

The proliferation of special purpose, quasi-independent districts has been a headache for Kentucky governmental units for many years. Experience with small water districts is an example of this problem. Inadequate funding and small service areas have been the root of many problems with special district. If it is imperative to form a special district, care should be taken to eliminate as many of these difficulties as possible in the formative stage.

A major change in powers of Kentucky's Fiscal Courts (County Government) was made in 1972. KRS 67.083 is popularly known as the County Home Rule Law. In a few sentences, the legislature granted counties lawmaking power similar to that enjoyed by cities. This Home Rule Law allows the counties to respond to solid waste problems by law much as cities have done. This could eliminate the need to form special districts. The county Fiscal Court can, by legislation, respond to solid waste problems. Daviess County has been a leader in the use of this legislation. They passed a litter law which should be easier to enforce than any existing legislation.

Other legislative possibilities are being explored by forward-looking Fiscal Courts to counteract the problems caused by uncontrolled solid waste.

Kentucky law provides alternate mechanisms for cooperative arrangements between units of government.*

Kentucky Revised Statute (KRS) 109 specifically allows contractual agreements between local units of government related to collection and disposal of solid waste. These contracts may be made without formation of any special district.

KRS 109 also controls the formation of "Garbage Disposal Districts," often referred to as "KRS 109 Districts." One or more local units of government may form a "KRS 109 District." This District is controlled by a board selected by the participating county judges and city legislative bodies. The 1974 Legislature allowed an optional salary for this board. The KRS 109 Board must approve any collection and disposal plans before the State Department for Natural Resources & Environmental Protection can approve them. This board may also make necessary contracts. However, the board may not serve a city without permission. A KRS 109 District Board has condemnation authority, may issue revenue bonds and levy a tax (not over ten cents per $100 assessed value). It also has power to levy a service charge which may be collected by utilities. A recent change allows discontinuance of a KRS 109 District upon petition by majority of freeholders and board.

The Interlocal Cooperation Act (KRS 65.210 *et. seq.*) provides for units of government to enter into agreements for joint action. These agreements must conform to certain specifications and be approved by the Attorney General. These special purpose districts may be expanded to include other units of government under certain conditions.

KRS 94.280 *et. seq.* detail powers of cities relating to solid waste, allowing for two alternative plans for solid waste control.

Kentucky's Statewide Solid Waste Control Law is codified as KRS 224.250 - 224.265 and 224.855 - 224.997.

KRS 224.250 declares it is the policy of the Commonwealth "to provide for the disposal of solid waste in a manner that will protect the public health and welfare, prevent the spread of disease and creation of nuisances, conserve our natural resources and enhance the beauty and quality of our environment."

The Solid Waste Disposal law requires a permit for any solid waste disposal site or facility. An exception is made for disposal of household waste on one's own land as long as no nuisance is created. Permits are also required for incinerators.

The Department for Natural Resources & Environmental Protection can only issue a permit for a disposal site after the applicant has notified the public of his intentions. A hearing may be requested. Permits are required for collecting, hauling and disposing of hazardous waste. The commissioner may require hauling licensing. Penalties may run as high as $1,000 per day of violation.

The new Kentucky Penal Code (KRS 434B. 2-070) provides that "criminal littering" is a Class B misdemeanor. A person is guilty of criminal littering when he: (a) Drops or permits to drop on a highway any destructive or injurious material and does not immediately remove it; or (b) Knowingly places or throws litter on any public or private property or in any public or private water without permission; or (c) Negligently places or throws glass or other dangerous pointed or edged substances on or adjacent to water to which the public has access for swimming or wading or on or within 50 feet of a public highway; or (d) Discharges sewage, minerals, oil products or litter into any public waters or lakes within the state. The penalty could be a fine up to $250 and/or imprisonment up to 90 days.

As this study went to press, Kentucky's Administrative Regulations were being changed. Requirements for construction and operation of landfills will be covered under Regulation 401 KAR 2:010. Every operator should be thoroughly familiar with these regulations. All aspects of solid waste disposal are covered, from initial planning of a landfill through the final closing process.

[*] Competent professional legal advice should be obtained before implementation of any proposed agreement

vii. financing

FINANCING

1. INTRODUCTION

Several financial alternatives were explored in developing the regional solid waste plan. It is necessary to analyze both capital and operating costs of such a plan.

In arriving at the total cost of operations, such a plan should be viewed from both an areawide viewpoint and the individual local government viewpoint.

This chapter will analyze total estimated costs for both systems, sources of funds, amortization recommendations and the availability of loans and grants.

2. REGIONAL VERSUS INDIVIDUAL COUNTY APPROACH

The regional approach to the financing of a solid waste plan would ideally consist of all seven counties cooperating. A less attractive choice would be a combination of two or more counties working together, with any remaining counties financing and operating their own individual systems. Any undertaking involving two or more counties will necessitate having contractual agreements on services to be rendered and providing for the financing of these services. The multi-county approach means lower unit costs and achieves greater economies of scale.

The individual county approach would be more costly to finance than involvement in a regional solid waste plan. Unit cost would be expected to increase and economies of scale would decrease. This approach would allow each unit of government more flexibility in programming services for that county. But along with that goes much duplication. For example, the individual approach would provide at least one packer truck for each county. The areawide approach would share vehicles and reduce the cost of having individual trucks.

Advantages of Areawide Approach:

1. Lower per unit cost
2. One administrative agency
3. Lower capital cost
4. Manpower sharing
5. Avoids duplication

Advantage of Individual County Approach:

1. More freedom in programming county solid waste services

3. SOURCES OF FUNDS

There are several sources of funds available for financing solid waste systems. These include revenues from the general fund, general revenue sharing funds, service charges, special tax levies, and the sale of bonds. Certain ones lend themselves to capital financing, while other funds would be more suited for operational expenditures. This will be discussed in detail later.

A. Capital Financing:

Almost without exception, it would be expected that general fund revenues would not be adequate for capital financing. Capital expenditures could be financed through general revenue sharing, a new solid waste tax, the sale of bonds, borrowed local funds, or lease purchase arrangements. An analysis of each method is discussed below:

1. General Fund Revenues Usually general fund revenues are already committed to existing programs. Surplus funds, if available, may be used.

2. General Revenue Sharing Revenue sharing funds can be spent on capital expenditures for environmental protection. Expenditures for solid waste programs fit this category. Capital expenditures are non-recurring. It is recommended that revenue sharing funds be used for these types of expenses.

3. New Taxes A solid waste district may levy a property tax to finance solid waste activities. Counties may levy an occupational license tax and these monies could be used to finance solid waste activities. One major disadvantage to the ad valorem tax is that it would place a heavier load on large property owners. Renters would pay no direct tax for solid waste services. Of course, the rent would reflect the landlord's tax load, including solid waste charges.

4. Service Charges - Charges may be levied by cities and counties for solid waste collection and disposal. The charge is directly related to service received.

5. Sale of Bonds - Bond issues may be used to finance solid waste capital expenditures. The main prerequisite to the salability of a bond issue is that adequate revenues be available to retire the issue.

6. Borrowed Local Funds - Financing may be available through local financial institutions. Ability to retire this type of debt would again be a prime prerequisite to securing funds.

7. Lease-Purchase Arrangements - The purchase of capital equipment can be arranged through lease-purchase agreements. It is suggested that other types of financing be explored first. Often finance charges are quite high in lease-purchase agreements. Comparisons of the cost of purchasing with this type of financing should be analyzed very closely to avoid unnecessary financing charges.

Recommendations:

Sufficient revenues must exist for the retirement of outstanding debt. The types of funds recommended for capital purchases are general revenue sharing funds, new tax funds, and borrowed funds at the local level or through bond issues. Both revenue sharing funds and new unobligated funds from taxes are primary sources of capital outlay funds.

Service charges will probably not generate sufficient funds for financing capital purchases, at least at the implementation stages of this plan. They can be used to retire borrowed funds, but this will significantly increase the amount of revenue needed from the service charge proceeds. Lease-purchase arrangements would also require the repayment of debt from a source such as a service charge or a new tax rate or amount of service charge would have to be higher than that which would be sufficient to finance only operational expenses.

B. Financing of Operations:

The same sources of revenue set out above could be used for financing the operations of a solid waste plan. It would be repetitive to enumerate these. However, it is important to note which ones lend themselves to this activity and which do not. On that basis, the following recommendations are presented.

Recommendations:

For all practical purposes, the use of bonds, borrowed funds, and lease-purchase arrangements apply only to capital purchases, since it would not be appropriate to use these types of funding for operations.

Existing general fund revenues are certainly appropriate for solid waste operational expenditures. But it would be expected that most of these are now obligated to existing activities.

A new tax for solid waste or a solid waste service charge is probably the best method of obtaining funds for operational expenses. This can be achieved under the home-rule legislation enacted by the 1972 General Assembly or through Chapter 109 of the Kentucky Revised Statutes.

General revenue sharing may be used for operations. However, the legislation authorizing revenue sharing expires at the end of 1976. There is no assurance that the program will continue. For that reason, general revenue sharing is not recommended for ongoing and recurring expenditures.

4. LANDFILL COSTS

The cost of solid waste disposal must be considered as a part of the total cost of solid waste operation. This would be in the form of service charges paid for using a site or the capital and operational costs of owning and operating a landfill.

Many expenses are involved in the purchase and operation of a landfill. These include land costs, legal fees, equipment, access roads, facilities (trailer, shed, water line, etc.), utilities, fencing, landscaping, and other miscellaneous costs.

Consideration should be given to the sharing of landfills. Economies of scale can be achieved in this manner, otherwise, duplication of costs will result.

5. DEPRECIATION AND AMORTIZATION

The cost of all capital expenses should be amortized over a period of years so that when replacements are needed funds will be available for these. Consideration should be given to the use of a reserve revolving fund for this purpose. Funds should be deposited periodically for the replacement of existing equipment so that at the end of the established depreciation time period, replacements can be purchased without "budget strain" or deficits.

6. LOANS AND GRANTS

Grants may be available at the time of implementation of a plan. Grant activity on the federal level usually looks toward development of new technology or other innovative projects.

Loans may be available at favorable interest rates. Rural areas will be at an advantage in dealing with Farmers Home Administration. Other low interest programs can be arranged through state government. Naturally, the availability of funds varies depending on demand and budget limititations.

If the system managers elect to franchise part or all of the solid waste operation, the financing picture will be altered somewhat. The franchise operator may absorb all capital costs and charge a fixed fee for his services. Billing may be provided direct by the franchise operator. If not, revenue generation will remain a governmental function. If a private contractor provides franchise service, he may be eligible for government loans, such as under the Small Business Administration.

viii. resource recovery potential

1. INTRODUCTION

The recovery of resources from the solid waste stream is an issue which is receiving nationwide attention. Recent federal legislation has emphasized resource recovery, and a number of communities have begun to seriously consider this potential alternative to their present refuse disposal practices.

Resource recovery can take either of two forms. Materials recovery, commonly termed recycling, is the extraction of usable resources from the bulk of the solid waste stream. One example of recycling is the recovery of ferrous metals, employing magnetic separators.

Another means of recovering resources from solid waste is the utilization of the waste as an energy source. This can be accomplished by burning the waste and capturing the energy thereby produced in one of several forms (heat, steam, gases, liquids or solids). Examples of these various applications include:

A. Direct use of heat for generation of electricity.
B. Production of steam for heating and air conditioning.
C. Production of methane to supplement natural gas supplies.
D. Production of synthetic fuel oils.
E. Production of solid fuel (char).

Energy recovery is not a new concept; the basic technology for various systems whereby resources may be extracted from solid waste is well established with regard to other processes. This technology has not been applied to any significant degree in the United States in the past, due to a number of economic disincentives. Most simply stated, it has been cheaper to rely upon our reserves of virgin resources than to attempt to recover any of the value which may be found in solid waste.

It would appear that this situation is now beginning to change, as a result of the cumulative effect of several interacting forces. One of these forces is the difficulty many communities are experiencing in obtaining suitable sanitary landfill sites. As communities expand and land values increase, the capital investment required to obtain a land disposal site also increases significantly.

Conflicts over zoning and land use often compound the problem of site location, resulting in costly delays and/or long hauling distances to disposal. Any reduction in the amount of waste to be disposed will increase the life of the disposal site by a proportionate amount. Resource recovery is one means whereby the amount of waste to be disposed can be reduced.

The dollar value of resources which can be obtained from refuse is largely controlled by the comparative cost of obtaining these resources from primary sources. Traditionally, the market for secondary materials has been limited, with demand varying widely and prices responding to this demand.

The use of solid waste as a fuel has likewise not been considered particularly feasible until recently. Shortages of petroleum products and the resulting demand for alternate energy sources has created a market situation in which it has been found feasible in some instances to utilize solid waste as an energy source.

It should be noted early in this discussion that the economic feasibility of any resource recovery system is largely a matter of scale. The capital investment required to implement such a system is sizable, and a steady flow of solid waste must be assured to maintain reasonable unit costs. For this reason, activity in the field of resource recovery has been largely confined to major metropolitan areas.

An illustration of how the economics of recovery systems improves with size is shown in Figure 9. The costs shown in this figure are net disposal costs (total cost less the value of resources recovered), and are based on the latest available national data. While the current strong secondary resources market has undoubtedly caused some change in the economics of the various processes, valid conclusions can still be drawn from this graph.

It can be seen that all the systems have a net cost of operation. In other words, cost exceeds the value of the resources recovered. Under ideal circumstances, the sanitary landfill is the most economical method available for the disposal of solid waste, consistent with sound environmental and public health principles.

Only in cases where it is necessary to haul long distances to disposal is resource recovery competitive with sanitary landfilling on a strict economic basis. As generation rates approach 1000 tons per day, however, this rule becomes less certain. Thus, in very large metropolitan areas where land is at a premium, it is sometimes cheaper to utilize some method of disposal other than landfilling.

As the need to haul greater distances to disposal occurs, this causes an upward shift in the curve representing the cost of sanitary landfill. The location of the curve marked "remote sanitary landfill" is not fixed, but will shift in direct relation to the cost of transporting the waste from generation areas to the point of disposal.

The relative order of costs for small to moderate sized recovery systems indicates that only two or three alternatives should be considered to have potential application within the Green River ADD. These are: fuel recovery, pyrolysis, and materials recovery.

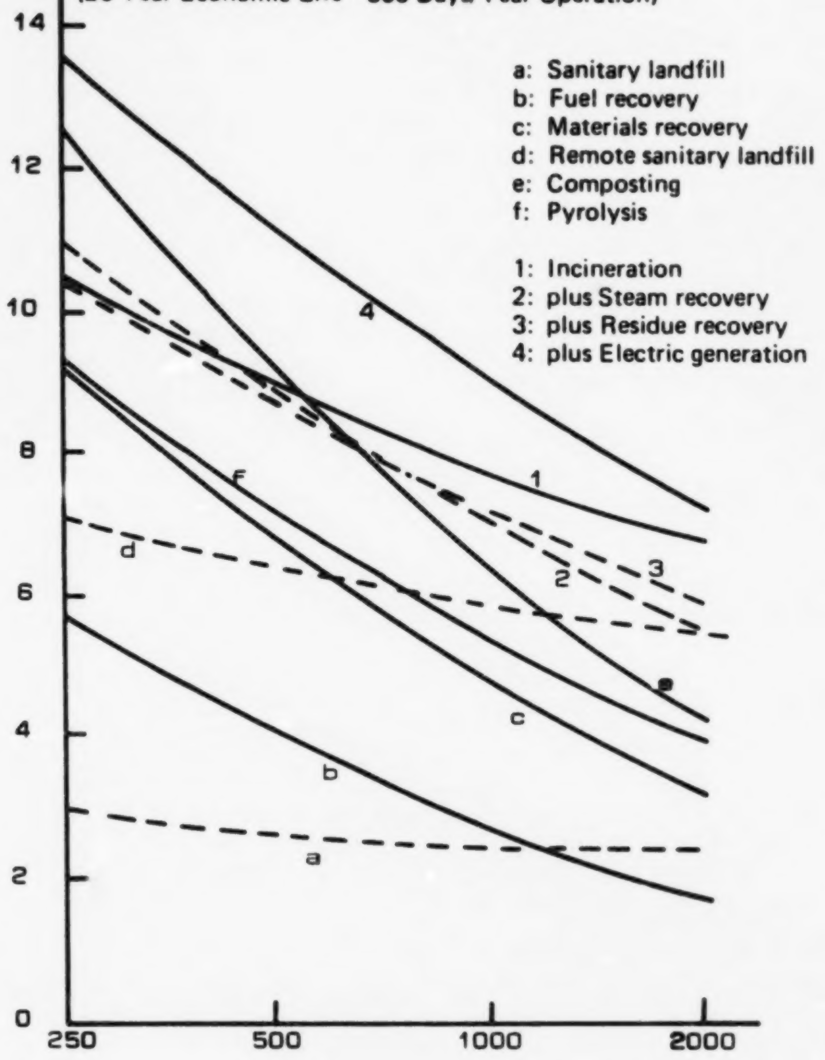
Incineration is shown to be prohibitively expensive in the lower size range ($9.00 $13.50 per ton, depending upon capacity and recovery methods employed). In addition, incineration for the production of steam or electricity is greatly dependent upon a constant flow of solid waste to the facility, since solid waste is the principal fuel involved in the incineration process.

FIGURE 9

NET DISPOSAL COSTS

MUNICIPALLY-OWNED RESOURCE RECOVERY SYSTEMS

(20-Year Economic Life - 300 Days/Year Operation)



SOURCE Midwest Research Institute, Economic Studies in Support of Policy Formation on Resource Recovery, Unpublished report to the Council on Environmental Quality, 1972

Composting is also seen to be expensive. The major reason is the lack of adequate markets for the compost which is produced. The history of composting in the United States has been beset with difficulties. During the late 1960's, a number of such facilities were constructed at various locations throughout the country. These plants varied in size from pilot scale (2 tons per day) to 600 tons per day in rated capacity, or larger. They were either privately owned and operated or the recipients of grant-in-aid assistance from the Federal government, under research and demonstration projects.

The following discussion provides a few typical examples of experiences with composting in this country. A 600 ton per day plant in St. Petersburg, Florida, constructed in 1966 at a cost of $\$2 \times 10^6$, was ordered shut down by local authorities in 1968 on the grounds that it constituted a "malodorous public nuisance". The Phoenix, Arizona, facility, 300 tons per day capacity, closed less than a year after it began operations, due to financial difficulties. A plant of similiar size in Mobile, Alabama, operated for eight months. It was forced to close because of repeated mechanical failures, lack of markets for the product, high operating costs, and odors.

Similar experiences were encountered in Oakland and San Fernando, California; Scarsdale, New York, McKeesport, Pennsylvania; Springfield, Massachusetts; Norman, Oklahoma; and Williamstown, Michigan. The Scarsdale, Oakland and McKeesport plants were pilot scale facilities.

In 1966, a demonstration composting plant was constructed at Johnson City, Tennessee. This facility was constructed to serve that city and to provide a site for research by the U.S. Public Health Service and the Tennessee Valley Authority. It was funded through a grant from PHS. The capital cost of the plant was slightly less than $\$1x10^6$ or \$18,580 per ton of rated capacity (52 tons). It should be noted that the rated capacity of the plant is apparently expressed in terms of an 8-hour day. Operating costs were found to be \$18.45 per ton of material processed, in 1968 dollars. The plant was closed upon termination of the grant which supported its operation.

Of the numerous composting plants built in the United States during the period from 1965 to 1970, virtually all have terminated operations. One source has summarized the reasons for their failure as including:

1. Extremely limited marketability for the end product.
2. Poor quality control of the final product.
3. High capital and operating costs, compared to other methods of disposal.
4. High percentage of non-compostable materials, requiring use of other disposal methods in conjunction with composting.

2. RESOURCE RECOVERY PROCESSES

A. MATERIALS RECOVERY: Materials recovery comprises a broad spectrum of systems, ranging in complexity from the very simple to the highly sophisticated. Several options therefore exist in the selection of a materials recovery system to complement a given set of circumstances in a particular waste generation area.

Among the simpler materials recovery systems are paper drives and community recycling centers. These systems generally function through the efforts of community service organizations and other volunteers. Successful volunteer programs have been reported for the recyling of newsprint, glass and aluminum beverage containers.

These programs are the least costly to the public, since manpower and often other expenses are donated. Another advantage which these simple systems offer is flexibility. The minimal capital investment (often none is required) allows the system to be "turned on and off" in response to demand, thereby taking advantage of price fluctuations.

The major disadvantage lies in the lack of continuity which is inherent in volunteer programs. Because of the lack of assurance that they will continue to function, volunteer programs should not be considered a permanent part of the solid waste management system.

Another low-capital-cost method of materials recovery is source separation; the separation of household refuse into its fractions by the homeowner prior to collection. Many communities presently require residents to separate their refuse for various reasons. One often-cited reason is to avoid hauling non-combustibles to incinerators, when incineration is practiced. It should be pointed out that separate collection creates additional collection costs, a factor which must be recognized in analyzing the total cost of the solid waste management system.

The most promising method of extracting resources from solid waste through source separation lies in the recovery of used newsprint. In many homes, newspapers are stored separately from the remainder of the household refuse until just prior to collection. They can, therefore, be kept separate at a minimum of inconvenience to the homeowner and to the collection forces.

Bound newspapers can be placed at curbside for collection in adverse weather conditions without affecting the acceptability of the material. Exposure to rain does not interfere with the recycling of newsprint, in which a wet process is employed.

Two methods of collecting newspapers for recycling are: (1) separate collection by special crews on specified days and (2) integrated collection by regular refuse collection personnel. Both methods are employed by a number of communities, and there are advantages to each. Separate collections, such as is practiced in Lexington, Kentucky, tends to reduce the amount of mixing with other refuse and may result in a greater percentage of recovery.

The City of Madison, Wisconsin, collects newspapers for recycling in conjunction with its regular refuse collection schedule. In order to accomodate the collection of newsprint by regular refuse trucks, the City has installed racks on the tops of the trucks and under the chassis along each side. The cost of these racks was minimal - in the order of \$200 to \$300 per vehicle.

It has been found in Madison that the racks fill up more rapidly than the packer itself. It has been necessary to provide for the in-route transfer of the newsprint to trailers stationed at key points along the routes. These trailers are then picked up and removed by another vehicle.

There is presently a strong market for used newsprint, although some fluctuation in price does occur. In 1972, recycled newsprint was selling for about \$20 per ton, f.o.b. the dealer. At that time, its use was found to have a cost advantage to manufacturers of \$27 per ton over the use of virgin material. In the past several months, the market for paper in general has strengthened considerably. Used newprint was selling for about \$31 per ton in

March of 1974. By May, the price had settled back to about $28 per ton.

De-inking facilities demand a large ensured daily supply of newsprint (one manufacturer has indicated a minimum of 300 tons per day) and usually draw from a large geographical area to meet this demand. However, practical limits on the amount of newsprint which can be sold for reuse do exist, since there are only a few de-inking plants in the United States and these are operating at or near capacity.

Correspondence with a major de-inking company indicates that company is now capable of handling some increase in the amount of newsprint which it processes. The company's nearest facility to the District, located in Chicago, is operating at about its maximum capacity. The closest facility to the District which could handle the waste newsprint load from the District is probably a plant located in the metropolitan New York area. Used newsprint could be sold directly to that facility, although the general practice is to sell to a local dealer who then resells to the manufacturer.

Another relatively accessible paper fraction is corrugated is relatively easily separated from the solid waste stream, since the bulk of the waste is generated by commercial customers. Where commercial service is separate from domestic, it is often found that the majority of the commercial waste is comprised of this type of paper.

Processing corrugated cardboard for market consists of removing foreign material, including other grades of paper, and volume reduction. Volume reduction is generally accomplished by baling.

Although newsprint and cardboard make up the major portion of recycleable paper in today's market, other grades of paper can also be sold under certain conditions. Mixed paper in clean condition is a commodity which fluctuates more in price than newsprint or cardboard. Prices for mixed paper ranged from $20 to $25 per ton in March of 1974.

Certain specialty papers command premium prices, but are generally available in limited supply. Notable among these are computer printout paper and data cards, which sell for as much as $50 and $200, respectively.

In addition to paper of various grades, materials which can be recovered from solid waste through volunteer efforts or source separation include aluminum and glass. Aluminum constitutes a relatively small percentage of the total waste load by weight, but has a high scrap value. Prices paid for aluminum scrap vary from 8½c to 16½c per pound, f.o.b. the dealer. The range is a function of the degree of purity of the scrap.

Used glass is generally accepted by all primary glass manufacturers. It is currently selling for about 1½c per pound, and prices are relatively stable. One major condition on the acceptance of used glass, applied by nearly all manufacturers and scrap dealers, is color separation. Glass is ordinarily separated into three categories: flint (clear), amber and green.

The recovery of materials from mixed municipal refuse involves two basic processes - size reduction and separation. Depending upon the desired nominal size of the product and the separation techniques to be subsequently employed, several methods of size reduction are available. These include hammermilling, shredding, pulverizing, rasp milling, and wet pulping.

By far the most commonly used equipment for the reduction of sized municipal refuse is the hammermill. Data made available by the U.S. Environmental Protection Agency in 1973 indicate the average capital cost for hammermills capable of processing municipal solid waste is about $2,500 per ton of rated hourly capacity. The smallest unit for which information was available was rated at 10 tons per hour, or 240 tons per day, and cost $30,000. Operating costs ranged from $0.56 per ton of material processed for the larger units to $1.06 per ton for a 10-ton unit.

Once size reduction has been accomplished, it is relatively inexpensive to separate the ferrous fraction. The capital investment required for magnetic separators is only a few thousand dollars, and the operating expenses could be expected to add only a few cents per ton to the total processing cost. Thus, the major expense involved in the separation of ferrous metals is in the size reduction phase rather than the separation process itself.

The market for ferrous scrap is erratic, and prices fluctuate according to demand. Price is also a function of the degree of purity of the scrap. There are some 40 grades of iron and steel scrap commonly utilized within the industry.

The ferrous metal component of domestic refuse is principally comprised of "tin" cans, which have a low market value as scrap. The presence of tin in scrap steel limits its use in the manufacture of new steel. For this reason, ferrous metals are not often removed from domestic waste, except in conjunction with other resource recovery processes.

A host of other separation techniques have been developed which take advantage of certain differences in the physical properties of materials, usually density. Examples of separators which operate on the density principle include ballistic separators, air column separators, and fluidized bed separators. Materials are usually separated into two fractions - light and heavy. The use of a series of such units provides for more complete refinement of these gross fractions and facilitates the production of reasonably pure end products.

The most complete materials recovery facility presently in operation is a demonstration plant located in Franklin, Ohio. Briefly, the plant consists of a liquid pulper for size reduction, magnetic separation, cyclonic separation into dense and light fractions, and optical separation of aluminum and glass.

The plant, which was funded through a grant from the U.S. Environmental Protection Agency, has a rated capacity of 150 tons per 24 hours. It is currently operating at about one-third its capacity. From this 50 tons of mixed waste are produced about 10 tons of low-grade paper fiber, 4 tons of glass cullet, 4 tons of ferrous metals, and 1 ton of aluminum.

The estimated value of these materials is $500. The cost of production at the design capacity has been projected to be $11 per gross ton of material processed, or about $1,650 for the 50 tons per day which are currently produced.

Projections of scale of operation by the manufacturer of the system indicate that a large facility (1,000 tons per day) could operate for as little as $2.90 per ton, or $2,900 per day, and produce materials worth as much as $8,600. The capital investment for such a facility would be from $\$12 \times 10^6$ to $\$15 \times 10^6$. All figures are in 1972 dollars.

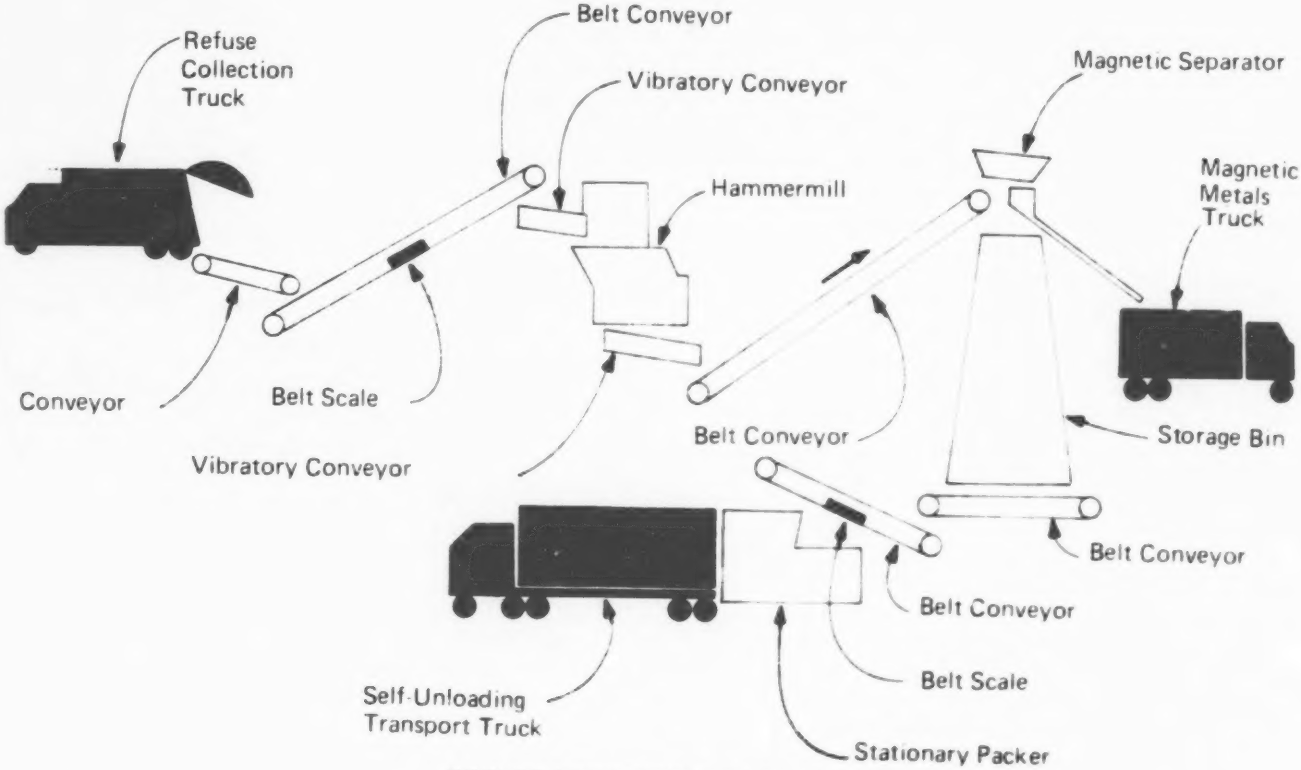
B. DIRECT FUEL RECOVERY: Direct fuel recovery is a process whereby solid waste is used as a supplemental fuel in coal-fired power generating plants. A prototype system of this type has been constructed at St. Louis, Missouri, under a grant from the U.S. Environmental Protection Agency.

The plant has been in operation since April, 1972, having been converted from a conventional coal-burning unit. It is tangentially fired and has a rating of 125 megawatts. It burns about 300 tons of refuse per 24 hour day, five days per week. This represents approximately 10% of the fuel demands of the boiler, by heating value. Since magnetic metals are removed prior to burning, about 320 to 330 tons of raw refuse are processed each day.

Tests at St. Louis have shown that typical residential refuse has a heating value of 4,200 - 4,500 Btu per pound, while the coal which is used at the plant (Illinois bituminous) has a Btu rating of about 11,500 per pound. Therefore, daily coal requirements at the facility have been reduced by around 130 tons.

It was determined that no modifications to the existing unit would be required to permit the burning of refuse, other than the installation of refuse burning ports. A fairly elaborate processing and delivery system was necessary, however, to provide a steady flow of refuse with the proper characteristics for burning.

FIGURE 10

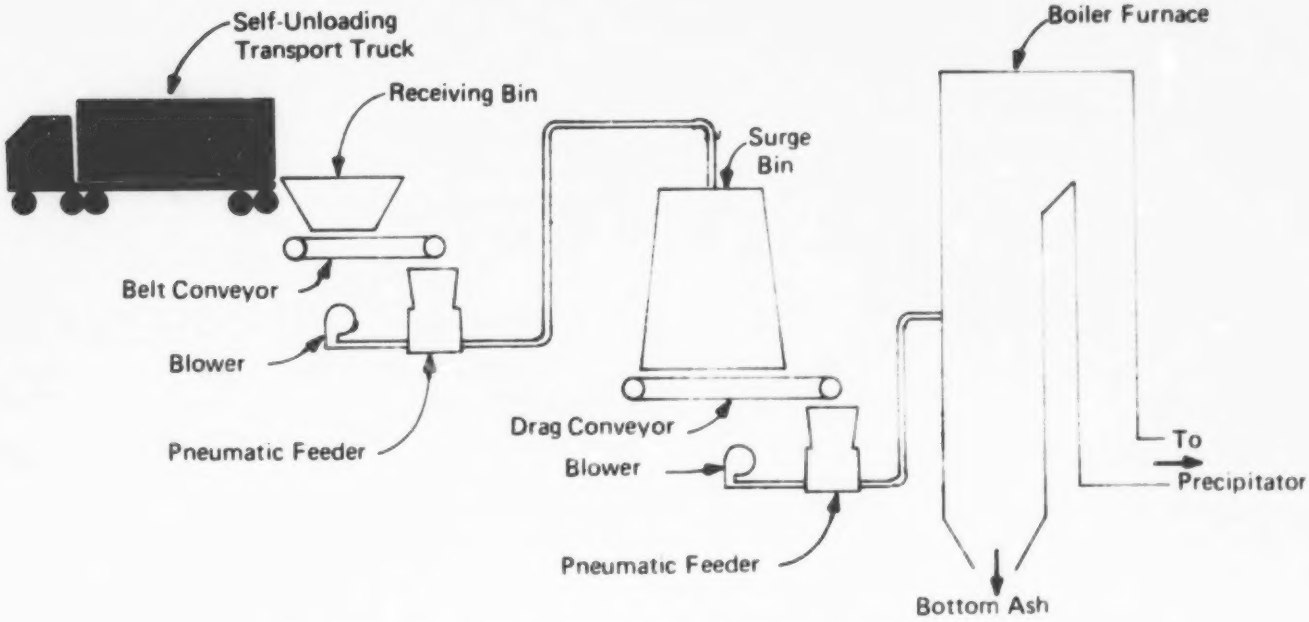


REFUSE PROCESSING FACILITIES

SOURCE: **Energy Recovery from Waste**, Horner & Shifrin, Inc., 1972

Figure 10 depicts the pre-processing facility, which performs two basic functions: (a) size reduction and (b) separation of ferrous materials. Raw refuse is received at the processing plant direct from the collection routes. It passes through a hammermill, where it is ground to a suitable size for burning, and then through a magnetic separator. The ferrous metal fraction is sold as scrap. The residue is packed into transfer trucks for delivery to the generating plant.

FIGURE 11



SUPPLEMENTARY FUEL RECEIVING AND FIRING FACILITIES

SOURCE: **Energy Recovery from Waste**, Horner & Shifrin, Inc., 1972

Figure 11 depicts the receiving and firing facilities. As previously stated, the only modification to the boiler furnace was the installation of refuse burning ports. The receiving (delivery) system consists of a receiving bin, a surge bin to equalize flow, and a pneumatic feeding system.

Early reports indicated that potential operating problems resulting from the burning of refuse were expected to be minimal. These possible difficulties included: increased tendency to slag, slightly increased corrosion potential, and an increase in the rate of ash generation. Although the possibility of increased air pollution was recognized, it was not considered likely.

Recent information has indicated, however, that a significant degradation in the quality of atmospheric emissions from the plant has occurred, based on results of a continuing testing program by the utility company. Although it would be presumptuous to state the cause of this occurrence, at least one plausible explanation exists.

Authorities on air pollution control indicate that electrostatic precipitators are sensitive to the amount of contaminants, particularly sulphur, found in the stack gases. These devices are designed for a specific installation, based on analysis of the fuel(s) normally used at that installation.

A comparison of refuse and coal, at the St. Louis plant, shows that the sulphur content of the refuse is about 0.25%, compared with about 3.5% for the coal, on a wet weight basis. Therefore, supplemental firing of refuse at the 10% rate results in approximately an 8% reduction in the daily sulphur load to the boiler. Other changes in the characteristics of the stack gases have also occurred; such as an increase in particulates.

It would appear from the latest information available concerning the St. Louis operation that modifications to an existing facility to permit the burning of refuse may require substantial changes in the air pollution control equipment. It is probably desirable, therefore, that future application of supplemental refuse burning be limited to new installations or installations not yet equipped with electrostatic precipitators.

C. PYROLYSIS: Pyrolysis can be defined as a process whereby oxidation occurs in a controlled oxygen atmosphere. It is sometimes also referred to as "destructive distillation". A layman's definition might be burning at high temperature in the absence of air.

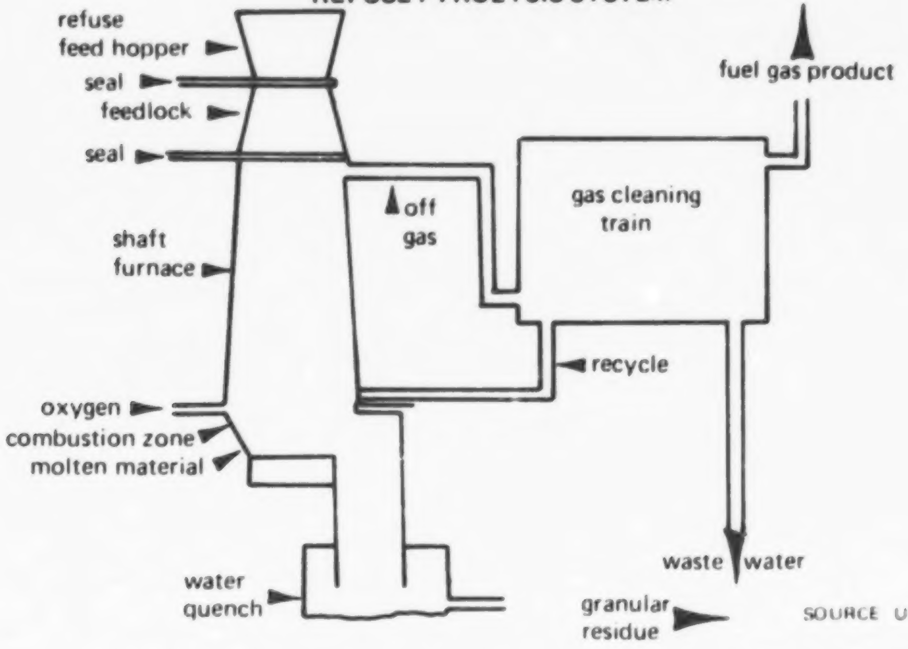
It is through the careful control of temperature and oxygen level that the final composition of the product of burning in a phyrolytic furnace is determined. This product can be gaseous (methane and other gases), liquid (a mixture of organic chemicals having characteristics similar to fuel oil), or solid (charcoal or carbon).

To date, pyrolysis of solid waste has been limited to laboratory scale operations and pilot plant facilities. Several educational institutions and private industrial companies have pursued various applications of the principles of pyrolysis. A full-scale municipal plant to serve the City of South Charleston, West Virginia, has recently been completed by the Union Carbide Company. It is scheduled to begin operation in 1974.

The purpose of this plant, which has a rated capacity of 200 tons per day, is to obtain operating experience and performance data for the full scale unit, and to confirm information obtained previously. All testing to date has taken place using a pilot scale plant with a capacity of 5 tons per day. If the 200 ton plant is successful, it is proposed by Union Carbide that it will serve as the basic module for facilities of larger scale, in multiples of 200 tons.

The end product of this particular process is a "fuel gas" having a heating value of approximately 300 Btu per cubic foot, or about one third the equivalent value of natural gas. The fuel can be sold to industrial consumers or blended with natural gas for general distribution.

FIGURE 12
REFUSE PYROLYSIS SYSTEM



SOURCE Union Carbide Corporation

Figure 12 illustrates the South Charleston system in schematic form. No cost data are available as yet for the facility. Data from Midwest Research Institutes indicate that small capacity pyrolysis facilities (250 tpd) have a cost of operation of about $9.00 per ton of material processed (1972 dollars)

3. WASTE GENERATION CHARACTERISTICS

A. DOMESTIC AND COMMERCIAL. No significant data are available concerning waste generation rates and domestic waste characteristics within the Green River Area Development District. Only one disposal site within the District is equipped with scales, and that site only recently. Records for that site, operated by the City of Henderson, for the period October 23 through November 12, 1973, indicate an average per capita generation rate of about 2 pounds per day, for residential and commercial waste.

This figure is significantly lower than the national average, which is about 2.36 pounds per capita per day for commercial waste. It is felt that the data which are available concerning the Henderson site are not representative of generation rates which might be expected in an area such as the Green River ADD. The seeming disparity might be accounted for in that the data for Henderson represent a very brief period of record in a season which is typically a time of low waste production. It may also be that the solid waste which is delivered to disposal is only a portion of the amount generated.

In arriving at an estimate of total residential and commercial waste generation within the District, a sliding scale has been used to compensate for anticipated differences in waste generation rates, as a function of the degree of urbanization. The following rates were assumed

Population	Generation Rate (lb/capita/day)
10,000	4.0
2,000 10,000	3.5
1,000 2,000	2.5
1,000	2.0
rural	1.5

Applying the above rates, it has been estimated that 90,000 tons of domestic and commercial solid waste are being generated within the Green River District annually, or an average of 2.75 pounds per capita per day. A breakdown of waste generation estimates by wasteshed and political subdivision is shown in Table 19.

TABLE 19

RESIDENTIAL-COMMERCIAL WASTE GENERATION ESTIMATES

GREEN RIVER AREA DEVELOPMENT DISTRICT

A
WASTESHED NO. 1

Census Division	1970 Population	Gen. Rate Lb./cap/day	Total Waste Ton/Yr.
Henderson Co.	4,484		
Corydon	880	1.5	1,227
Corydon (c)	2,832	2.0	321
Hebbardsville	23,311	1.5	775
Henderson	4,524	4.0	17,017
Spottsville		1.5	1,238
Union Co.			
Morganfield	1,725	1.5	472
Morganfield (c)	3,563	3.5	2,276
Sturgis East	1,786	1.5	489
Sturgis West	1,090	1.5	298
Uniontown	3,898	1.5	1,067
Uniontown (c)	1,255	2.5	573
Waverly (c)	355	2.0	130
Webster Co.			
Clay	962	1.5	263
Clay (c)	1,426	2.5	651
Wheatcroft (c)	229	2.0	84
Dixon	1,338	1.5	366
Dixon (c)	572	2.0	209
Providence	770	1.5	211
Providence (c)	4,270	3.5	2,727
Sebree	2,347	1.5	642
Sebree (c)	1,092	2.5	498
Slaughtersville (c)	276	2.0	101
TOTAL	65,195		33,047

(c) city

TABLE 19 (Cont'd.)

B
WASTESHED NO. 2

Census DIVISION	1970 Population	Gen. Rate No./cap/day	Total Waste Ton/Yr.
Daviess Co.			
Owensboro	50,864	4.0	37,130
Owensboro West	2,952	1.5	808
Stanley	3,188	1.5	872
Utica	2, 685	1.5	735
West Louisville	2,382	1.5	652
Whitesville	864	1.5	237
McLean County			
Calhoun	1,935	1.5	530
Beech Grove (c)	233	2.0	85
Calhoun (c)	901	2.0	329
Livermore	1,163	1.5	318
Livermore (c)	1,594	2.5	727
South	2,389	1.5	654
Island (c)	410	2.0	150
Sacramento (c)	437	2.0	160
Ohio County			
Beaver Dam	1,642	1.5	449
Beaver Dam (c)	2,622	3.5	1,675
Centertown	921	1.5	252
Centertown (c)	323	2.0	118
Hartford	305	1.5	84
Hartford (c)	1,868	2.5	852
Heflin Beda	1,773	1.5	486
McHenry Rockport	1,413	1.5	387
McHenry (c)	420	2.0	153
Rockport (c)	377	2.0	138
TOTAL	83,661		47,981

(c) = city

TABLE 19 (cont'd)

C
WASTESHED NO. 3

Census Division	1970 Population	Gen. Rate No./cap/day	Total Waste Ton/Yr.
Daviess Co.			
Maceo	5,456	1.5	1,494
Owensboro East	7,753	1.5	2,122
Whitesville	2,590	1.5	709
Whitesville (c)	752	2.0	274
Hancock Co.			
Hawesville	1,524	1.5	417
Hawesville (c)	1,262	2.5	658
Lewisport	1,100	1.5	301
Lewisport (c)	1,595	2.5	728
Patesville	1,599	1.5	438
Ohio County			
Beaver Dam	1,095	1.5	300
Fordsville	2,097	1.5	574
Fordsville (c)	489	2.0	178
Hartford	1,221	1.5	334
Heflin-Beda	443	1.5	121
Horse Branch	1,781	1.5	488
TOTAL	30,757		9,136

(c) – city

TABLE 20

COMPOSITION OF TYPICAL DOMESTIC/COMMERCIAL WASTE

Waste Component	Percent By Wet Weight			
	A	B	C	Average
Paper	43.3	45.2	48.0	45.5
Glass	8.7	11.0	6.0	8.6
Ferrous Metals	6.0	10.4	8.0	7.8
Non-Ferrous Metals		0.8		0.6
Putrescible Organics	24.7	21.4	25.0	23.7
Plastic, Leather, Rubber	4.1	8.8	3.0	3.3
Textiles	2.0			1.6
Wood	1.8		2.0	2.3
Other	9.4	2.4	8.0	6.6
Total	100.0	100.0	100.0	100.0

SOURCE (a) Parrott, Ely and Hart, Consulting Engineers, Inc. **Data Regarding Recycling Solid Wastes in 16 Southeastern Kentucky Counties**, Lexington, Kentucky 1973

(b) Midwest Research Institute, **Research Recovery, The State of Technology**, U.S. Government Printing Office, Washington, D.C., 1973

(c) Hagerty, D.J., J.L. Pavoni and J.E. Heer, **Solid Waste Management**, Van Nostrand Reinhold Co., New York, 1973

No detailed information concerning the composition of residential and commercial waste generated in the District is available. Detailed studies have been made in other areas, however, and the pattern has been found to be similar in most situations throughout the country. Table 20 shows a comparison of waste composition analyses resulting from some of these investigations. It can be seen that no significant difference exists between the three sources of data. An average of the three has been used in the evaluation of the potential for recycling of domestic and commercial waste within the ADD.

B. INDUSTRIAL: A survey of industrial solid waste characteristics in the Green River ADD was conducted by the Kentucky Division of Solid Waste in late 1972 and early 1973. During that time, all industries within the District appearing in the current edition(s) of the Kentucky Directory of Manufacturers were interviewed with respect to their waste handling practices.

The total number of industries surveyed was 173, representing all major Standard Industrial Classification (SIC) groups except two (Ordinance and Instruments). A breakdown of the industries within the District, by product and by county, appears in Table 21.

TABLE 21

INDUSTRIAL ESTABLISHMENTS

GREEN RIVER AREA DEVELOPMENT DISTRICT

1973

S.I.C. Code	PRODUCT	COUNTY							
		Daviess	Hancock	Henderson	McLean	Ohio	Union	Webster	GRADD
20	food & food prod.	20	1	5	3	3	5	2	39
21	tobacco	5	0	0	0	0	0	0	5
22	textiles	0	0	1	0	1	1	0	3
23	apparel	0	0	2	2	1	0	0	5
24	lumber & wood prod.	5	0	3	0	4	2	5	19
25	furniture	3	0	5	3	0	0	0	11
26	paper	0	1	2	0	0	0	1	4
27	printing & publishing	6	2	2	0	2	1	2	15
28	chemicals & chem. prod.	4	0	1	0	0	2	0	7
29	petroleum refining	2	0	0	0	1	0	0	3
30	rubber & plastics	1	0	7	0	1	0	0	9
31	leather	0	0	0	0	1	0	0	1
32	stone, clay & glass	5	1	1	0	0	1	0	8
33	primary metals	1	4	1	0	0	0	0	6

TABLE 21

(cont'd)

S.I.C Code	Product	COUNTY							
		Daviess	Hancock	Henderson	McLean	Ohio	Union	Webster	GRADD
34	fabricated metal prod.	8	1	2	1	1	3	0	16
35	machinery	7	0	0	0	1	0	2	10
36	electrical equipment	3	0	0	0	1	0	0	4
37	transport. equipment	0	0	4	0	0	0	1	5
39	misc. ind.	2	0	1	0	0	0	0	3
	TOTALS	72	10	37	9	17	15	13	173

SOURCE: Kentucky Division of Solid Waste, **Industrial Solid Waste Survey Data Sheets.**

The results of this survey will serve as the basis for all estimates of industrial waste volumes and characteristics, since it comprises the most complete source of information regarding industrial waste handling practices within the District that is available. Data from this survey are not absolute, however, and it should be recognized that they represent only approximate values (see Table 22).

Conversations with personnel of the Division of Solid Waste indicate that, in most instances, figures for salvaged materials represent only that amount of material which is salvaged within the plant, and does not include that which may be collected by secondary materials dealers. Therefore, it can be expected that the amount of materials salvaged, particularly the more valuable ones, is somewhat greater than indicated by the survey.

During the survey, quantitative information was reported both by volume and by weight. Those data which were expressed in terms of volume (cubic yards) have been converted to units of weight (tons). In so doing, certain assumptions have necessarily been made. These assumptions include:

1. For mixed or non-specific categories of materials, it has been assumed that the entire volume consists of the probable most common material (e.g.: non ferrous metal such as aluminum).
2. In many instances, an average density factor of 0.5 has been assumed, recognizing that storage practices will have significant bearing on the actual density of the material. For example, glass cullet will have a density factor of nearly 1.0, while whole or broken glass containers will have a much lower density.
3. It has been assumed that estimates of paper quantities which have been expressed in cubic yards are in loose storage. Only one of the firms surveyed was found to be using stationary compaction, and that firm did not report any paper waste.

Table 23 shows the factors which have been used in converting from volumetric to gravimetric units of measure.

In evaluating the potential for resource recovery from industries within the District, only materials which are presently disposed should be considered, since those which are being salvaged are already in the resource recovery stream. In gross terms, about 42% of the waste products from industry are currently being salvaged. Principal among these materials are animal wastes (100%), leather (91%), rubble (77%), non ferrous metals (70%), and wood (61%).

Those materials which have apparent potential for increased recycling and their current rate of salvage are glass (7%), paper (8%), and ferrous metals (30%).

As an alternative to recycling, utilization of certain fractions of the industrial waste loan in an energy recovery system can also be considered. The use of domestic waste as a fuel for power generation, as practiced in St. Louis, does not require the separation of inert or undesirable materials, since residential waste is relatively homogeneous after milling. The addition of industrial wastes to such a system should be done with care to preclude the introduction of "slugs" of undesirable material which would be deleterious to the system.

For that reason, only specific industrial wastes have been considered herein as potential fuels. Those industrial wastes which should be acceptable as fuel include food wastes (garbage), paper, textiles, mixed trash, and wood.

TABLE 22

INDUSTRIAL SOLID WASTE GENERATION
GREEN RIVER AREA DEVELOPMENT DISTRICT

WASTE	DAVIESS COUNTY			HANCOCK COUNTY			HENDERSON COUNTY			McLEAN COUNTY			OHIO COUNTY		
	G	D	S	G	D	S	G	D	S	G	D	S	G	D	S
Animal Wastes	0	0	0	0	0	0	1,505	0	1,505	0	0	0	0	0	0
Ashes	902	897	5	104	104	0	55	55	0	0	0	0	204	204	0
Chemicals	1,455	1,117	338	8,301	141	8,160	8,552	8,552	0	0	0	0	60	60	0
Crop Wastes	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferrous Metals	12,478	2,358	10,120	654	0	654	25,007	24,827	180	11	0	11	348	348	0
Food Wastes	454	449	5	122	122	0	0	0	0	26	0	26	6	6	0
Glass and Pottery	1,433	1,005	428	4,500	4,500	0	1	1	0	0	0	0	41	41	0
Leather	4	4	0	0	0	0	0	0	0	0	0	0	40	0	40
Non-Ferrous Metals	34	6	28	0	0	0	253	80	173	0	0	0	0	0	0
Paper	1,977	1,694	283	635	635	0	877	877	0	26	26	0	107	107	0
Plastics	479	479	0	0	0	0	4,238	4,238	0	0	0	0	7	7	0
Rubber	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubble	4,961	1,461	3,500	1,675	0	1,675	60	60	0	0	0	0	0	0	0
Textiles	7	7	0	11	11	0	88	88	0	21	21	0	161	156	5
Trash, Mixed	1,975	1,975	0	98	98	0	4,307	4,307	0	7	7	0	0	0	0
Wood	9,005	5,449	3,556	599	321	278	10,946	100	10,846	0	0	0	5,724	1,044	4,680
Miscellaneous															
Al_2O_3 Slag	25,000	25,000	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete	800	800	0	0	0	0	0	0	0	0	0	0	0	0	0
Limestone	0	0	0	0	0	0	0	0	0	0	0	0	23,750	23,750	0
Steel Slag	960	960	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	61,996	43,733	18,263	16,699	5,932	10,767	55,699	43,015	12,684	91	54	37	30,496	25,771	4,725

WASTE	UNION COUNTY			WEBSTER COUNTY			GRAND		
	G	D	S	G	D	S	G	D	S
Animal Wastes	50	0	50	0	0	0	1,555	0	1,555
Ashes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,265	1,260	5
Chemicals	59	59	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8,498
Crop Wastes	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]
Ferrous Metals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Food Wastes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31
Glass and Pottery	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	428
Leather	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	44	4	40
Non-Ferrous Metals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	201
Paper	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plastics	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Rubber	[illegible]	[illegible]	[illegible]	0	0	0	1	1	0
Rubble	[illegible]	[illegible]	[illegible]	0	0	0	6,696	1,521	5,175
Textiles	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	290	285	[illegible]
Trash, Mixed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	0
Wood	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]
Miscellaneous									
Al_2O_3 Slag	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	25,000	25,000	0
Concrete	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	800	800	0
Limestone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	23,750	23,750	0
Steel Slag	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	960	960	0
TOTALS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	172,068	124,823	47,245

G : Amount of waste generated (Tons/yr)
D : Amount of waste disposed (Tons/yr)
S : Amount of waste stockpiled (Tons/yr)

SOURCE: Kentucky Division of Solid Waste, [illegible]

TABLE 23

PROPERTIES OF MATERIALS

Material	Specific Wt. (No./ft^3)	Tons/Yd.^{3}	f*	Adjusted Tons/Yd^3
Animal waste		0.50	1.0	0.50
Ashes		0.40[a]	1.0	0.40
Chemicals	62	0.84	1.0	0.84
Crop Waste		0.25	1.0	0.25
Ferrous metal	490[b]	6.62	0.5	3.31
Food Waste		0.50[a]	1.0	0.50
Glass & pottery	150[b]	2.02	0.5	1.01
Leather				0.30[c]
Non-ferrous metals	169[b]	2.28	0.5	1.14
Paper		0.05[a]	1.0	0.05
Plastics	70[b]	0.95	0.5	0.48
Rubber	75[b]	1.01	0.5	0.50
Rubble	140[b]	1.89	0.5	0.95
Textiles				0.30[c]
Trash, mixed		0.25[a]	1.0	0.25
Wood	30[b]	0.41	0.5	0.20

f* = assumed density factor

SOURCES

a. **Refuse Collection Practice,** American Public Works Association, Chicago, Ill., 1966.

b. Murphy, Glenn, **Properties of Enigneering Materials,** International Textbook Co., Scranton, Pa., 1957.

c. **Base Data Regarding Recycling Solid Waste in 16 Southeastern Kentucky Counties,** Parrott, Ely and Hurt, Consulting Engineers, Lexington, Ky., 1973.

C. JUNK AUTOMOBILES: Although abandoned vehicles must be recognized as a potential source of secondary ferrous metal, and possible other materials to a more limited extent, no formal effort has been made to determine the existing inventory of these vehicles in the Green River ADD. Thus, any attempt to estimate the number of abandoned, or junked, vehicles for purposes of this Plan must be based on data from other geographical areas. Since this portion of the Plan deals with waste in terms of its potential value as a resource, a conservative approach is considered appropriate.

Only those vehicles which have been abandoned along highways or on private property are considered to be potential sources of increased supply of secondary materials. Those autos which have been collected by established dealers and are being held in inventory are considered to be in the secondary materials stream at the present time.

A number of investigations have been conducted throughout the country during the past several years, the purpose of which has been to estimate junk car densities. Many of these studies have been broad in scope, covering entire states or other large geographical areas. At least one such study has been conducted on a nationwide scale, by the U.S. Bureau of Mines in 1967. In that study junk auto handling practices were investigated in a number of localities of varying characteristics with regard to population, degree or urbanization, proximity to scrap markets, etc.

One of the areas included in the study was comprised of Carter, Elliott, Lewis and Rowan Counties in Northeastern Kentucky. Estimates of abandoned vehicles in the area were obtained through interviews with public officials. It was estimated that 1,650 junked vehicles were located in the four counties, outside wrecking yards. This represents an average of about 30 vehicles per 1,000 population. It was noted in the report that this estimate was considered to be substantially less than the actual number.

In a study conducted by the Tennessee Department of Public Health in 1970 and 1971, survey teams made a relatively detailed investigation of two rural counties (Dickson and Loudon) and one urban county (Shelby). The survey was conducted by automobile, and an actual count of all apparently derelict vehicles visible from the roadway was made. Results of that survey were as follows:

County	Abandoned Vehicles per 1,000 Population
Dickson	126
Loudon	114
Shelby	32

In 1973, an actual vehicle count was made in the Cumberland Valley and Kentucky River Area Development Districts in Southeastern Kentucky, by means of a helicopter survey. All vehicles in groups of 24 or less were included in the actual inventory; estimates were made for all major accumulations. It was found, through ground checks in random areas, that this method resulted in significantly more complete counts than ground survey techniques.

Slightly over two thirds of the total were found to be in groups of 24 or less, the remainder being primarily located in salvage yards. Junk car densities were found to be 138 per 1,000 population in the Cumberland Valley and 114 in the Kentucky River Area. It is recognized that socio economic and photographic characteristics in Southeastern Kentucky make it likely that the abandonment rate is higher than in the Green River Area, and that a smaller percentage of junk autos find their way into salvage yards.

Application of density factors from these investigations should be done with caution, since many local factors affect the number of vehicles which are abandoned in any locality. A conservative estimate of the number of abandoned vehicles, by county, is provided below.

County	Abandoned Vehicles per 1,000 Population	Total
Daviess	40	3,180
Hancock	80	570
Henderson	40	1,440
McLean	80	725
Ohio	80	1,500
Union	80	1,270
Webster	80	1,065
GRADD	54	9,750

There is a small local market for junk automobiles, per se, in or near the District. Two processors, one in Owensboro and one in Evansville, Indiana, have the capability of handling automobile hulks. One accepts only stripped and burned vehicles.

D. WASTE GENERATION PROJECTIONS. It is recognized that one of the major factors affecting the feasibility of resource recovery operations is volume. Throughout this discussion, reference is made to the economies inherently found in large scale operations, and to the fact that the waste load in the District is such that resource recovery appears to be marginally feasible, at best. Certainly, other factors also affect feasibility; notably, prevailing prices for secondary materials and efficiency of collection and transportation. In the final analysis, however, waste load volume has a significant effect on the feasibility of resource recovery.

Since resource recovery facilities must be amortized over extended time periods (20 years is the common practice), it is desirable to be able to predict changes in waste load volume which may occur over such a period of time. Unfortunately, little information is available to aid in the development of such a prediction. In fact, as can be seen by the discussions above, very little is known about the actual waste load volumes at the present time. Thus, predictions of future volumes are essentially based on judgement.

Recent history of solid waste generation has been characterized by a continuing increase in the per capita generation rate. National average figures in the order of 5½ pounds per capita per day have been cited, based on a survey conducted in the late 1960's. Projections as high as 9.0 pounds per capita per day by 1980 have been made.

It is now believed that these estimates and projections are too high, and that the present national average per capita generation rate is around 4.0 to 4.5 pounds per day. It appears likely that solid waste generation rates will be affected to some degree by current shortages of natural resources, and that they will tend to stabilize somewhat in the foreseeable future.

The future domestic and commercial waste load within the District will be a function of changes in both the population base and per capita generation rates. Population projections for the Green River Area Development

District were provided by the Kentucky Program Development Office in 1972. These projections have been used as a basis for waste load projections.

Compound annual growth rates of 1.0%, 0.0%, and -1.0% have been applied to the estimated current solid waste generation rate for the District. Based on these projected changes in population and waste generation rate, it is expected that the 1980 waste load will be between 91,103 and 109,075 tons per annum. Low and high estimates of the annual tonnage in the year 1990 are 93,437 and 136,627, respectively.

No attempt has been made to estimate the future industrial waste load within the District, since this component of the solid waste stream is subject to wide variation. The relocation of a single major industry in the District could affect the industrial waste load significantly.

4. RESOURCE RECOVERY POTENTIAL

A. GENERAL: A number of factors exist which tend to discourage resource recovery in the District at this time. One major consideration is the availability of land disposal sites, placing resource recovery at an economic disadvantage. Because there do exist in the District large surface mined areas where sanitary landfilling could be rather easily performed, the District has been actively considered as a potential location for the establishment of a large disposal site to serve the upstream metropolitan areas of Louisville and Cincinnati.

The waste load from the District is too small to permit the economy of scale which would allow the operation of recovery facilities at optimum levels of efficiency. It has been estimated that the total amount of waste generated by domestic and commercial sources is in the order of 250 tons per day.

Generally speaking, prior attempts at resource recovery have involved waste loads of at least this magnitude or larger. Some exceptions do exist, primarily pilot scale facilities which were not intended to function on a continuing basis, but rather to permit the testing of technological concepts. It can be concluded, therefore, that the successful recovery of resources on a significant scale is contingent upon the ability to accumulate a substantial portion of the waste generated at one central processing site.

Another negative factor with respect to the feasibility of resource recovery is the character of the existing refuse collection system. At the present time, no mechanism exists whereby refuse from throughout the District can be transported to a central location.

The establishment of a Districtwide rural containerized collection system would constitute a step toward centralization, particularly if a plan involving a limited number of disposal sites were implemented. Refuse generated in the rural areas represents about 23% of the total waste load (57 tons per day). The major cities of Owensboro and Henderson generate about 150 tons per day, or 60% of the total waste load. The remaining 24 incorporated communities account for the remainder (42 tons per day).

Industrial waste not presently recycled contributes an additional 432 tons per day. Only about 100 to 150 tons can be considered as having potential for recovery. The remainer includes such non-usables as rubble, concrete, slag, crop waste, etc.

Consideration has been given to the possibility of drawing upon population centers outside the District to increase the supply of raw material for a proposed recovery facility. Although the fact that Owensboro and Henderson are major Ohio River ports makes it possible that cities as far away as Cincinnati might be willing to barge their waste to the facility, this cannot be considered a likely assumption at this time.

The location of Evansville, Indiana, on the other hand, being directly across the Ohio from Henderson, makes it reasonable that the waste load from this community be included in the assessment of resource recovery feasibility. The Evansville Standard Metropolitan Statistical Area (SMSA) includes Vanderburg County, Indiana, and Henderson County, Kentucky. The 1970 Census gives the SMSA a population of 232,775. Of this total, 196,774 persons are located in Indiana, and 138,765 within the corporate limits of Evansville. Using an assumed generation rate of 4.0 lb/cap/day for domestic and commercial waste, and making no allowance for industrial waste, an additional 275 tons of waste per day could be obtained from this source.

Based on the generation rates established for use in this discussion, the maximum waste load available to a central processing facility, assuming 100% collectability is around 600 tons per day. Of this, 425 tons would come from the cities of Henderson, Owensboro, and Evansville in the form of domestic and commercial waste.

It can be seen from the above discussion that the feasibility of resource recovery in the Green River ADD would be greatly enhanced by the participation of the City of Evansville. Because of the relatively small geographical area in which the major portion of the waste load is generated, it is felt that further efforts toward resource recovery should be concentrated in the Henderson Owensboro Evansville area.

It is believed that the City of Evansville might be receptive to discussions concerning a mutual resource recovery venture at this particular time. Collection and disposal services within the city are presently provided under contract with a private company. The sanitary landfill is nearing completion, and no alternative sites are available at this time. Evansville has recently created a new agency to deal with problems related to air and water pollution control and solid waste disposal. This agency, the Evansville Environmental Protection Agency, has expressed an interest in resource recovery.

The inclusion of wastes from other sources within the Green River ADD should be based on a comparison of the value of the resource to the difference between disposal cost and the added cost of transportation to a central facility. It may be found that implementation of a centralized rural collection system will allow the economical delivery of the rural portion of the waste load to such a facility.

B. MATERIALS RECOVERY: The four fractions of domestic and commercial solid waste generally considered to have recovery potential are: (1) paper, (2) ferrous metals, (3) non-ferrous metals, and (4) glass. Table 24 provides an estimate of the quantities of each of these materials available in the domestic waste stream (including commercial) and in the industrial waste stream. Domestic tonnages are based on previously discussed generation rates and composition. Industrial quantities are from the Industrial Solid Waste Survey.

From the experience at the Franklin, Ohio, recycling plant, waste from Owensboro, Henderson and Evansville could be expected to yield the following daily quantities of materials: paper pulp 75 tons, aluminum 2 tons, iron 25 tons, and glass 17 tons. The gross value of the metals and glass, at current market prices, would be about $1,250 per day. The value of the paper pulp has not been determined.

Potential markets exist for each of these resources. One salvage dealer and several beverage packaging plants in Owensboro accept scrap aluminum. Goodwill Industries, Inc., operates a recycling center in Evansville, and plans to establish another in Owensboro in the near future. They are presently receiving 200 to 300 pounds of scrap aluminum per week, and are able to market all they receive.

Although there are several aluminum industries in the Green River ADD, all but one are primary manufacturers and, as such, require a select grade of scrap. Some utilize only "home" or "prompt" scrap. Two manufacturers, one in the District and one in adjacent Indiana, have indicated that they will accept secondary scrap. Each prefers to receive scrap in carload lots, crushed and baled. One company also accepts copper scrap, which is used in the manufacture of aluminum.

Scrap aluminum is currently selling for as much as $.15/lb., on the local market, depending on quality.

There is less opportunity to market secondary glass locally, since there are no primary glass manufacturers in the area. Used glass (principally bottles) is, nevertheless, a product with good marketability at the primary manufacturer level. Any glass collected within the District could be sold, provided quantities were sufficient to offset the cost of transportation to the customer. The nearest known buyer of used glass is located in Lawrenceburg, Kentucky.

There is at least one primary steel industry in the District, which industry is a potential market for the ferrous metal fraction. This manufacturer employs modern processing techniques which are capable of using large volumes of scrap. There are also several scrap dealers located in Evansville who purchase scrap iron and steel. Most of these have limited processing capabilities and cannot handle bulky goods such as automobiles and major appliances.

TABLE 24
MATERIALS RESOURCES

GREEN RIVER AREA DEVELOPMENT DISTRICT

A. PAPER

COUNTY	TONS/DAY		
	Domestic	Industrial	Total
Daviess	56.1	4.6	60.7
Hancock	3.2	1.7	4.9
Henderson	25.7	2.4	28.1
McLean	3.7	0.1	3.8
Ohio	8.2	0.3	8.5
Union	8.4	0.1	8.5
Webster	7.2	0.0	7.2
GRADD	112.5	9.2	121.7
Evansville, Ind.	125	N/A	125
TOTAL	237		246

TABLE 24
(cont.)

B. FERROUS METALS

COUNTY	TONS/DAY		
	Domestic	Industrial	Total
Daviess	9.6	6.5	16.1
Hancock	0.5	1.8	2.3
Henderson	4.4	1.5	5.9
McLean	0.6	0.0	0.6
Ohio	1.4	1.1	2.5
Union	1.4	0.0	1.4
Webster	1.2	0.1	1.3
GRADD	19.1	11.0	30.1
Evansville, Ind.	21.5	N/A	21.5
TOTAL	40.6	11.0	51.6

C. NON-FERROUS METAL

COUNTY	TONS/DAY		
	Domestic	Industrial	Total
Daviess	0.7	0.0	0.7
Hancock	0.0	0.0	0.0
Henderson	0.3	0.2	0.5
McLean	0.0	0.0	0.0
Ohio	0.1	0.0	0.1
Union	0.1	0.0	0.1
Webster	0.1	0.0	0.1
GRADD	1.3	0.2	1.5
Evansville, Ind.	1.7	N/A	1.7
TOTAL	3.0	0.2	3.2

D. GLASS

COUNTY	TONS/DAY		
	Domestic	Industrial	Total
Daviess	10.6	2.8	13.4
Hancock	0.6	0.0	0.6
Henderson	4.8	0.0	4.8
McLean	0.7	0.0	0.7
Ohio	1.6	0.1	1.7
Union	1.6	0.0	1.6
Webster	1.4	0.0	1.4
GRADD	21.3	2.9	24.2
Evansville, Ind.	23.7	N/A	23.7
TOTAL	45.0	2.9	47.9

N/A = Not Available

There are local markets for certain select grades of paper. One Evansville firm accepts clean waste paper, including cardboard, computer printouts and tabulator cards. A Hawesville firm accepts significant quantities of corrugated cardboard (25,000 tons per year), but apparently is already capable of meeting its demands.

In evaluating the feasibility of materials recovery, primary consideration has been given to a "complete" recovery system, such as the one in Franklin. The primary product of that facility is paper pulp. Because of the high liquid content of this pulp, it may not be practicable to consider markets other than those in close proximity to the processing facility. The Franklin recovery plant was located adjacent to a major pulp consumer for this reason. The only pulp consumer in the District is the Hawesville plant mentioned above.

Materials recovery offers some potential on a scale smaller than the Districtwide concept which has been the primary emphasis throughout this discussion. Certain select materials could be recovered at the local (city or county) level, in small quantities. In order to minimize capital requirements, it is believed that such activities should be confined to the recovery of cardboard, newsprint and clean ungraded paper. Market commitments should be obtained prior to the implementation of a collection program.

Methods which might be utilized for the separate collection of waste paper have been previously cited. As an alternative, separation at the disposal site might be accomplished. The experience of a small system in western Tennessee is related below as an example of a system of this type.

In July of 1973, Benton County, Tennessee, began separating clean waste paper from the mixed refuse received at the county sanitary landfill. This was done primarily as a means of extending the useful life of a small site which was rapidly being depleted. Capital requirements to implement the system, including a small building, a forklift and a used baler, amounted to approximately $30,000.

The amount of material recovered has ranged from about 30 tons during the first month of operation to about 100 tons in June of 1974. This increase is, to a substantial degree, the result of separate paper collection activities in surrounding counties. Labor costs for the 12 month period were approximately $25,000, and gross revenues about $33,000.

C. DIRECT FUEL RECOVERY: Table 25 provides an estimate of the quantity of refuse available for use as fuel. The figures for domestic refuse represent 70.4% of the total waste load, and include paper, putrescible organics, plastics, leather, rubber, textiles and wood. See Table 20.) It has been found that the light, or combustible fraction of domestic waste can be expected to range from 75% to 80% of the total waste load. Figures for combustible industrial waste are from the Industrial Survey.

TABLE 25

TOTAL ENERGY RESOURCE BY COUNTY
GREEN RIVER AREA DEVELOPMENT DISTRICT

COUNTY	TONS/DAY		
	Domestic	Industrial	Total
Daviess	94	28	122
Hancock	5	3	8
Henderson	43	26	69
McLean	6	1	6
Ohio	14	4	18
Union	14	1	15
Webster	12	16	28
GRADD	188	78	266
Evansville, Ind.	210	N/A	210
TOTAL	398	78	476

N/A = Not Available

It is estimated that the combustible waste load from Owensboro, Henderson, and Evansville totals 375 tons per day, or the equivalent of 40 tons of coal. This is about 25% greater than the tonnage handled by the St. Louis demonstration facility, which feeds a 125 megawatt generating unit.

In an attempt to determine the position of utility companies in the area toward the use of refuse as a supplemental fuel, inquiries have been made to the several companies in and near the District. Their response is a mixed reaction, varying from rejection of the concept to a willingness to consider the possibility of refuse firing, if it can be shown to be to their economic advantage.

Any one of the companies which responded currently consumes sufficient fuel to absorb the total burnable waste load generated in the District and adjacent Evansville. However, it is the consensus that the experience of Union Electric Company at St. Louis demonstrates the desirability of designing a new facility specifically around the characteristics of a mixed fuel.

It was stated by one respondent that a ready market exists in the area for increased electrical power. Thus, the potential does exist for the construction of a new power plant, using refuse as a supplemental fuel.

The market value of refuse as a supplemental fuel is a matter which must be negotiated with the potential customer. It will depend on his interest in the concept, as well as the price and availability of coal. The current (March, 1974) value of the equivalent 140 tons of West Kentucky coal is $1,260 $1,680.

Ferrous metals recoverd in the pre processing facility might provide an additional source of revenue. The quantity of ferrous metals obtainable from 425 gross tons of mixed refuse would be approximately 33 tons, and would be worth as much as $400.

D. PYROLYSIS. As a method of resource recovery, pyrolysis has not been subjected to full scale testing, as have other methods discussed herein. Pilot plant operations appear to support the thesis that pyrolysis constitutes one of the more economical methods of resource recovery currently available.

According to the results of one pilot study, one ton of raw refuse will produce 0.7 tons of fuel gas. Refuse from Owensboro, Henderson and Evansville would therefore generate about 330 tons of fuel gas per day, or the equivalent of 3×10^6 cubic feet of natural gas, by heating value. The current industrial rate for natural gas in the area is 56c per 1,000 cubic feet. Assuming a wholesale value of about 45c for natural gas, or 15c for fuel gas, the market value for fuel gas in the area could be as much as $1,350 per day.

Pyrolysis equipment has taken many different forms, as research by several independent companies has progressed toward field testing. A review of the literature indicates that in some instances the technology is similar to that currently being considered with regard to coal gasification. It may be that current interests in coal gasification in the Green River Area are compatible with the pyrolysis of solid waste.

5. CONCLUSIONS AND RECOMMENDATIONS

Certain specific resource recovery applications appear to have sufficient potential for implementation within the Green River Area Development District to warrant further investigation. It is not likely that all waste generators within the District will be able to participate in such a system, however. Relatively small waste loads and dispersity of generation areas are negative factors with regard to a recovery facility serving the entire population of the Area.

For this reason, future efforts toward resource recovery should be concentrated in the more heavily populated areas of the District, including Daviess and Henderson counties. Even so, the predicted waste load from these two counties is not sufficient to provide the economy of scale which is a primary factor affecting the unit costs of any major resource recovery facility. The participation of the City of Evansville in a joint venture with these urban areas would provide an adequate population base to assure a daily waste load which has been found sufficient to permit resource recovery at several locations throughout the United States.

Participation in a resource recovery system by communities other than those mentioned above should be determined by comparing the transportation costs to be incurred with the cost of sanitary landfilling at sites near the generation areas. The implementation of a Districtwide rural containerized solid waste collection system could have a positive influence in this regard.

For those communities which do not find it economically feasible to participate in a resource recovery facility, it is suggested that consideration be given to a limited materials recovery program. Current information regarding market conditions indicate that such a program might be restricted to newsprint and corrugated cardboard recovery. While there is a ready market for scrap aluminum, it does not appear to be practicable to attempt to recover this product from mixed waste on a small scale.

Methods of resource recovery which appear to have potential application with regard to a centralized facility include fuel recovery for electric power generation, pyrolysis and materials recovery. Each of these systems would require a significant capital investment, and should be subjected to more detailed investigation before definite commitments are made. It is felt that either of the two energy recovery methods has greater applicability than does materials recovery, based on local market conditions.

As more detailed planning for resource recovery occurs in the District, the possibility of future grant in aid assistance should not be overlooked. House Bill 14161, which was recently introduced in the United States

Congress, would provide substantial assistance in the planning, engineering design, construction and capital amortization of facilities to recover energy from solid waste. Should this bill be passed in its present form, it would amend the present Solid Waste Disposal Act to permit such assistance without the requirement that the facility demonstrate new technology, as is presently required.

Short range measures which can be taken in the Green River Area Development District with regard to resource recovery include:

A. Collection of newsprint.
  1. Obtain tentative market commitments.
  2. Locate one or more receiving centers. The Regional disposal sites selected elsewhere in this Plan are suggested.
  3. Encourage newprint collection by established refuse collectors, particularly municipalities.
  4. Provide for separate newspaper collection along containerized rural routes, when implemented.
  5. Develop public information programs to encourage participation.

B. Recovery of cardboard.
  1. Confirm tentative markets.
    a. Alton Box Board Co., Evansville
    b. WesCor Corp., Hawesville
  2. Establish tentative processing center locations, in conjunction with operating landfills.
    a. Wastesheds should be of sufficient size to assure that at least 150 tons of cardboard can be recovered per month at each site. (The proposed Regional disposal sites meet this criterion.)
  3. Perform detailed design of processing facilities and cost/benefit analyses.
  4. Implement, if feasible.

C. Recovery of aluminum and copper.
  1. Because of the difficulty in recovering these materials from mixed waste, it is recommended that short-range measures be restricted to encouragement of volunteer efforts, particularly through a public information program designed to inform public service organizations of existing markets.
    a. Aluminum Company of America, Newburgh, Indiana.
    b. National Aluminum/National Steel Corp., Hawesville.
    c. Goodwill Industries, Inc.
      (1) Owensboro.
      (2) Evansville.

D. Junk automobile retrieval.
  1. Request the assistance of the Kentucky Department for Natural Resources and Environmental Protection in conducting a short-term program for the removal of junk cars.
    a. From public lands.
    b. From private properties, with owners' permission.
  2. Private firms may be employed by DNREP for this purpose.

It is recommended that the long range resource recovery program for the District be geared to energy-related systems, and that the initial effort be restricted to areas of dense population. The following specific steps are suggested:

A. Develop the necessary working relationships between the several governmental agencies to be involved in the initial efforts.
  1. Owensboro Henderson County.
  2. Henderson Henderson County.
  3. Evansville Vanderburg County.

B. Conduct detailed surveys necessary to provide base data with regard to feasibility, including:
  1. Quantity and composition of refuse.
  2. Required transportation network.
  3. Evaluation of "remote" sources, including the proposed District rural collection system.

C. Initiate negotiations with potential energy markets.

D. Select system and develop preliminary engineering design and feasibility study.

E. At the appropriate time, create or designate a legal entity eligible to receive grants under the Solid Waste Disposal Act, charging it with the responsibility of acting on behalf of the participating local governments in the development of an energy recover system.

F. Based on the results of short range activities in junk car removal, determine the necessity and feasibility of establishing a self-supporting, permanent program.

In summary, resource recovery appears to have sufficient potential application to warrant further efforts. The successful implementation of resource recovery will depend not only on the economic factors involved, but also on the commitment of local leadership to the concept.

ix. county-by-county solid waste system

IX. COUNTY-BY-COUNTY SOLID WASTE SYSTEM

This section contains a series of proposals to be used **only** if a regional or multi-county system is impossible to organize. The first recommendation of this study is a regional system. The regional system provides the lowest cost combined with the highest possible level of service. Design of an individual county system should look forward to eventual establishment of a regional system. All equipment should be compatible.

The second alternative for the District's solid waste system is a county-by-county solid waste system. Each county would operate its own collection and disposal system.

The same type of containerized system is proposed here. The existing disposal sites have been recommended here except in Union County where the proposed Morganfield city landfill would be used. As in the regional system, county collection is proposed for the rural areas. Disposal sites may be shared with the cities or with the private operations.

A solid waste system for each county is outlined in Table 26. Note that this alternative would require eight packer trucks and would use eight disposal sites to serve seven counties compared to four trucks and three centralized disposal sites in the regional alternative. (See Figure 13)

The equipment and personnel in most counties would be idle most of the time because of the smaller service area. This would create more burden on the citizens.

In the individual system, there will be more freedom in programming the service, and there will not be any contractual agreement with other public governments. But it will have higher capital and unit cost of service.

COLLECTION AND DISPOSAL

The county collection system will serve the rural areas. Most of the cities without collection service are too small to start their own system. They should either join with the countywide collection system or contract to a private company.

This containerized collection system is flexible in that it would be possible to expand its service to the cities without any major additional capital cost or operation costs.

Each collection system would use either a 24 or 30 cubic yard front loading packer truck and 6 cubic yard containers. Container sites and routes are laid out according to road networks and population centers of the county. The supervisor will keep records for each operation, and the truck drivers will be responsible for the improvements of the routes. Initially, the container sites will be experimental until the most suitable locations can be determined.

Regular cleaning, painting, and deodorizing of the containers are recommended. A complete operational record keeping form is shown in the appendix. It is strongly suggested that a radio communication system be used for efficient route operation, emergencies, and to avoid delays in collecting missed containers on the route. A minimum of one day per week is provided for equipment maintenance and operation analysis.

Since there will be a uniform type of system in each county and the workload is generally for two to three days a week, equipment from a neighboring county should be requested during truck breakdown.

Tables 28 to 52 show route schedules and capital and operation cost of collection for each county. The maps in the appendix show the locations of containers, routes, and disposal sites.

Each county will be using its existing disposal site in the county, operated by either the county, a city, or a private company. Since these sites have major equipment facilities, only additional equipment and personnel would be required to operate according to state regulations.

The disposal charge will be paid according to the yearly tonnage of waste load. This cost may vary from approximately $1.50 to $2.00 per ton, or 50c to 75c per cubic yard, or a fixed yearly charge. Additional equipment and personnel needs at each site are discussed, along with the collection cost of each county. Table 27 shows the capital and operation cost for a new, typical county sanitary landfill.

Recommendations for landfill operation and maintenance are listed in the appendix and also in the regional disposal system section.

The cost figures, for the most part, reflect standard unit costs for each county. This depends on the services desired. For example, the cost of a two ton truck and driver has been included for each county. It may be determined that this is not needed; therefore, costs will decrease. Or a county may choose to buy a smaller truck, thus reducing the cost, etc. These needs must be decided by the officials in each county.

TABLE 26

COUNTY BY COUNTY SOLID WASTE SYSTEM

COUNTY	DAVIESS	HANCOCK	HENDERSON	McLEAN	OHIO	UNION	WEBSTER
Population (1975)	84,135	7,832	37,756	9,090	19,010	16,340	13,419
Rural Population	28,000	4,975	10,256	5,330	14,000	8,000	5,970
No. of Rural Residential Units	7,753	1,495	3,200	1,775	4,650	2,100	1,806
No. of Rural Commercial Units	150	20	45	30	86	25	42
Expected Waste Volume (Tons/Year)	8,450	1,450	2,925	1,787	4,190	1,625	1,820
No. of Front End Loader Packer Trucks	2	1	1	1	1	1	1
Size of Packer Truck (Cu. Yd.)	30	24	30	24	30	30	24
No. of Containers (6 Cu. Yd.)	97	36	69	43	61	44	46
Disposal Sites	County Landfill, Owensboro Landfill, Proposed Landfill	County Landfill	Henderson City Landfill	County Landfill	County Landfill	Proposed Landfill	Private Landfill

FIGURE 13

FIG-13 REGIONAL SYSTEM VS. INDIVIDUAL COUNTY SYSTEMS

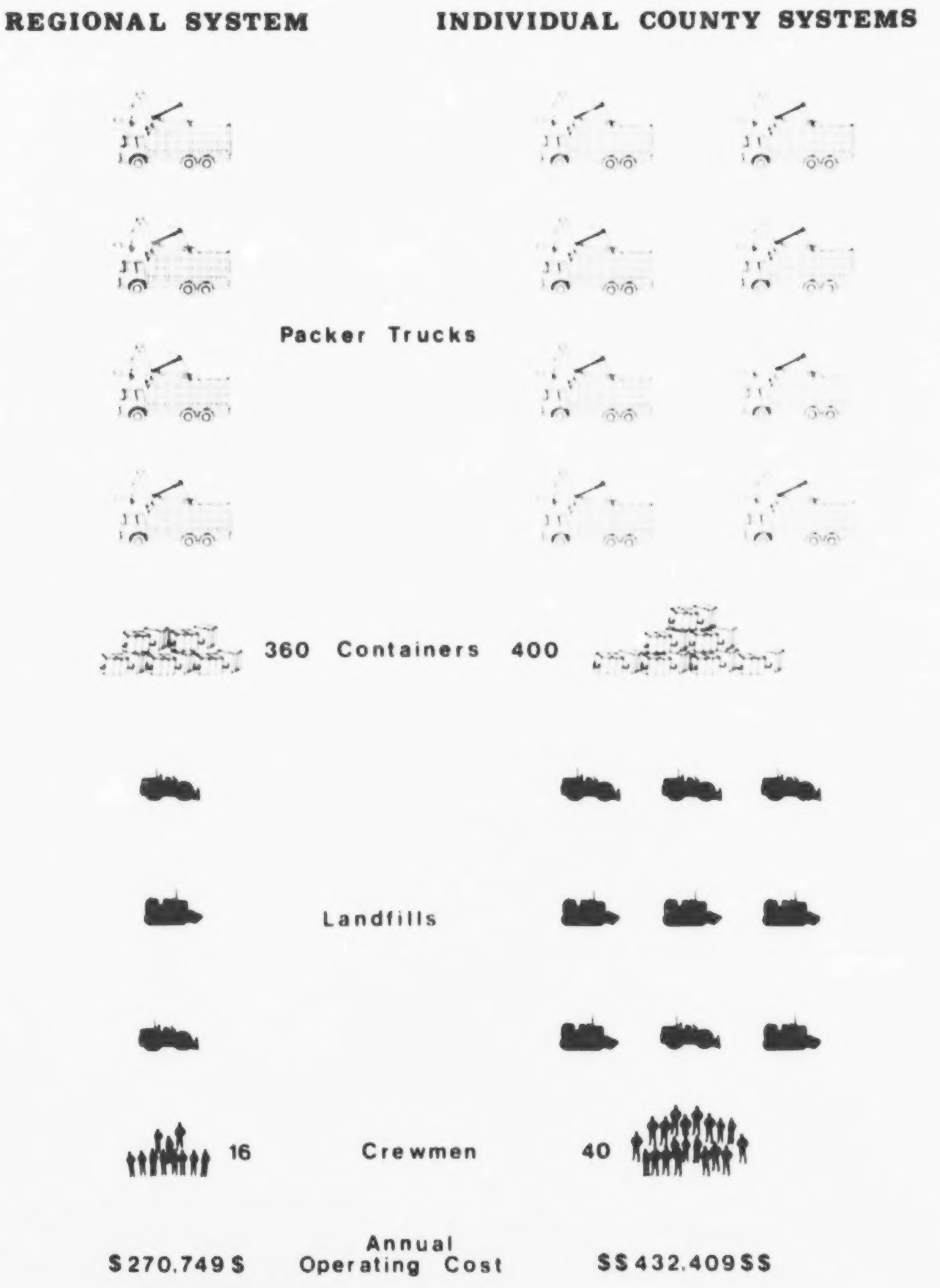


TABLE 27

INDIVIDUAL
COUNTY LANDFILL COST

CAPITAL COST

Item	Life (Years)	Total Cost	Yearly Cost*
Bulldozer	8	$42,000	$7,014
Scales	20	8,000	752
Shelter	10	4,000	568
Fence	10	500	70
Radio Communication System	10	500	70
Site Preparation	5	1,000	244
Access Road	5	5,000	1,220
Total Capital Cost		$61,000	$9,938

OPERATING COST

Dozer Operation (3 hrs./day, 5 days/week, $2.50/hour)	$ 1,950
Scale Operator ($500/month plus 5.2% FICA)	6,312
Dozer Operator/Supervisor ($550/month plus 5.2% FICA)	6,943
Landfill Attendant ($450/month plus 5.2% FICA)	5,690
Total Operating Cost	$20,895
Total Yearly Cost	$30,833

*Yearly cost includes depreciation and 7% interest cost

Recommendations on Financing:

Several different means of financing solid waste collection and disposal is available to each county.

1. Property Tax Rate. The fiscal court may levy a tax for solid waste services pursuant to Chapter 109 of the K.R.S. With this method, collection of revenues is easier and administrative expenses are lower. However, this plan of financing places the entire burden of producing revenue on real estate and personal property owners and taxpayers and does not reflect a true picture of service received by taxpayers for taxes paid by that taxpayer.
2. Service Charges. This type of charge for solid waste services is usually levied in the form of a monthly charge to the occupant of each house in the county. This may be accomplished by cooperative agreements with utility companies.

   An alternative approach would be an individual bill for services to each household, but there is reason to believe that collections with this type of system would be very difficult. This is not recommended unless no other form of collection is possible.
3. General Revenue Sharing. Counties may spend revenue sharing funds for capital and operating expenses for solid waste within the environmental protection and conservation section of the Revenue Sharing

legislation. It is strongly recommended that Revenue Sharing funds not be used for operation and maintenance expenditures. There is the possibility that these funds will not be available after 1976. The use of these funds for initial capital investment is wise, and units of government are encouraged to use these funds for capital expenditures.

Other Recommendations:

The annual operating costs reflected herein provide amortization schedules for capital equipment. Counties should strongly consider annual revenue charges sufficient to cover the purchase of new equipment at the end of the amortization period as well as regular operational costs. As current revenues are received, that portion of money necessary to amortize the capital equipment should be set aside periodically so that these funds will be available and ample when the need for new equipment arises.

1. DAVIESS COUNTY

Each truck would work for four days a week for twice-a-week collection. Total miles and time shown in Table 28 are for once-a-week service routes. During the emergency breakdown of one truck, the other truck would be used to carry out the routes except on Tuesdays and Fridays.

Table 29 shows capital and operating costs of the collection system. The average monthly collection cost per household would be about 94c.

Three disposal sites are recommended here to handle waste from the eastern, central, and western part of the county as shown on the map in the appendix.

TABLE 28

DAVIESS COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time (Hrs. Min.)	Disposal Site (Landfill)	Day	
					Truck No. 1	Truck No. 2
1	13	40	3:00	County	M. Th.	
2	8	50	3:00	County	M. Th.	
3	12	28	2:30	City	T.Fri.	
4	12	39	3:00	City	T.Fri.	
5	15	22	2:30	Proposed*		W. Sat.
6	8	33	2:30	Proposed		W. Sat.
7	14	31	2:30	Proposed		W. Sat.
8	15	65	4:30	Proposed		T. Fri.
TOTAL	97	308	23:30			

*Proposed landfill is the proposed site in the southwestern part of the county near Whitesville. (See map in appendix.)

TABLE 29

DAVIESS COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly* Cost
Front Loading Packer Truck	30	5	2	$30,000	$ 60,000	$14,633
Containers	6	10	97	450	43,650	6,215
Portable Steam Cleaner	-	10	1	1,500	1,500	214
Portable Paint Sprayer**	-	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	-	10	2	500	1,000	142
TOTAL CAPITAL COST					$114,150	$22,851

OPERATION COST

Salaries:

1 Supervisor @ $8,000 / year	$ 8,000
2 Drivers @ $6,500/year	13,000
4 Crewmen @ $5,500/year	22,000
TOTAL	$43,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$13,142
Fuel and Maintenance	15,000
TOTAL	$28,142

TOTAL OPERATING COST	$71,142
TOTAL YEARLY COST	93,993
Average Monthly collection cost per household	$0.94

---

*Yearly cost includes depreciation and 7% interest

**Cost includes miscellaneous tools

The existing Daviess County landfill would serve two eastern routes with about 260 cubic yards of waste load each week. To operate this landfill up to standards, it is recommended that shelter, equipment shed, scales, fence, and radio communication unit be installed. The landfill has a full time attendant and a part time dozer operator. The additional capital and operating cost are shown in Table 30.

TABLE 30

DAVIESS COUNTY LANDFILL COST

ADDITIONAL CAPITAL COST Item	Life (Years)	Total Cost	Yearly Cost*
Scales	20	$ 8,000	$ 752
Shelter	10	4,000	568
Fence	10	500	70
Radio Communication Unit	10	500	70
TOTAL CAPITAL COST		$13,000	$1,460

ADDITIONAL OPERATING COST

Scale Operator ($500/month plus 5.2% FICA)	$6,312
TOTAL ADDITIONAL OPERATING COST	$6,312
TOTAL ADDITIONAL YEARLY COST	$7,772

---

* Includes depreciation and 7% interest cost

The central routes (500 cubic yard/week load) of the system would use the City of Owensboro landfill. The county would be required to pay a disposal charge at this landfill. Assuming that the minimum disposal charge is $1.70/ton, the annual disposal cost to the county at this landfill would be approximately $5,525.

The third proposed landfill site is shown in the southwestern part of Daviess County. But it is recommended that the Ohio County proposed landfill, which is about two miles south of the previously proposed landfill in the plan, be used. The weekly waste load at this landfill would be approximately 450 cubic yards. The disposal cost would be $1.70/ton or approximately $4,975 per year.

TABLE 31

DAVIESS COUNTY

COST SUMMARY

Capital cost of collection		$114,150
Additional capital cost of disposal		13,000
TOTAL CAPITAL COST		$127,150
Total yearly operating cost of collection		$ 93,993
Total yearly operating cost of disposal:		
1. County landfill	$7,772	
2. Owensboro city landfill	5,225	
3. Proposed landfill	4,975	
		17,972
Yearly cost of collection and disposal		$111,966
Average monthly cost of collection and disposal per household		$1.12

If the present operation cost at the existing county landfill is considered, the monthly cost per household will increase to about $1.25 to $1.50.

2. HANCOCK COUNTY

A 24 cubic yard front loading packer truck would serve 36 containers in four routes once a week as shown in Table 32. (See Appendix for container locations and routes.) The workload would require only two days per week. The equipment and labor would become idle most of the time. However, this type of system has proved to be more economical than house-to-house collection for a small rural county.

Table 33 shows the capital and operating cost of collection. The average monthly collection cost per household will be about $2.37. This is comparatively higher than other counties because of the fewer residential and commercial users.

The plan recommends the existing county landfill as the disposal site for this countywide system. This site would require additional equipment and labor for a complete operation. Since the landfill has a dozer and operator, the additional facilities would include a scale, fence, personnel and equipment shelter, and radio communication unit.

TABLE 32

HANCOCK COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time (Hrs. Min.)	Day
1	11	45	3:00	M
2	7	25	2:00	M
3	7	20	2:00	Th.
4	11	35	3:00	Th.
TOTAL	36	125	10:00	

TABLE 33

HANCOCK COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu. Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck	24	5	1	$26,000	$26,000	$ 6,341
Containers	6	10	36	450	16,200	2,280
Portable Steam Cleaner	–	10	1	1,500	1,500	214
Portable Spray Painter**	–	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	–	10	1	500	500	70
TOTAL CAPITAL COST					$52,200	$10,552

TABLE 33 (Cont'd)

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year	$ 8,000
1 Driver @ $6,500/year	6,500
1 Crewman @ $5,500/year	5,500
TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$ 6,280
Fuel and Maintenance	8,000
TOTAL	$14,110

TOTAL OPERATING COST	$34,110
TOTAL YEARLY COST	44,662
Average monthly collection cost per household	$2.37

---

*Yearly cost includes depreciation and 7% interest

**Cost includes miscellaneous tools cost

Table 34 shows additional capital and operating cost for the county landfill.

TABLE 34

HANCOCK COUNTY LANDFILL COST

ADDITIONAL CAPITAL COST

Item	Life (Years)	Total Cost	Yearly* Cost
Scale	20	$ 8,000	$ 752
Shelter	10	4,000	568
Fence	10	1,000	140
Radio Communication Unit	10	500	70
Access Road Improvement	5	1,000	244
TOTAL ADDITIONAL CAPITAL COST		$14,500	$1,774

ADDITIONAL OPERATING COST

Dozer Operation (3 hrs./day, 2 days/week, $2.75/hr.)	$ 858
Scale Operator @ $550/month plus 5.2% FICA	6,312
TOTAL ADDITIONAL OPERATING COST	7,170
TOTAL ADDITIONAL YEARLY COST	8,944

---

*Includes depreciation and 7% interest cost

TABLE 35

HANCOCK COUNTY

COST SUMMARY

Capital cost of collection	$52,200
Additional capital cost of disposal	14,500
TOTAL CAPITAL COST	66,700
Total yearly operating cost of collection	44,662
Total additional yearly operating cost of disposal	8,944
YEARLY COST OF COLLECTION AND DISPOSAL	53,606
Average monthly cost of collection & disposal per household	$2.80

3. HENDERSON COUNTY

The containerized collection system is in operation in this county. The county has one 30 cubic yard front loading packer truck and 60 six cubic yard containers located in the rural area and in the City of Corydon.

This plan proposes to provide extra containers (and relocation of some containers to avoid overlodaing of the containers) and a definite route schedule as shown on the map in the appendix.

Table 31 shows the complete collection route outlay.

TABLE 36

HENDERSON COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time (Hrs. Min.)	Day
1	14	38	2:45	M
2	14	52	3:00	T
3	15	40	3:00	W
4	12	40	3:00	Th.
5	14	38	3:15	Fri.
TOTAL	69	208	15:00	

The above table shows five working days. This could be cut down to four or three days with more working hours each day.

The capital and operating cost of the collection system are shown in Table 37.

Total capital cost and yearly operating cost for the proposed system would be $71,050 and $48,389. However, the additional cost to the county for the existing countywide system would be for maintenance equipment and additional personnel which would be approximately $9,050 for capital and $9,283 for operation.

TABLE 37

HENDERSON COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck[1]	30	5	1	$30,000	$30,000	$ 7,317
Containers[1]	6	10	69	450	31,050	4,421
Portable Steam Cleaner	—	10	1	1,500	1,500	214
Portable Spray Painter**	—	10	1	3,000	3,000	428
Pickup Truck[2]	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	—	10	1	500	500	70
TOTAL CAPITAL COST					$71,050	$13,669

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year	$ 8,000
1 Driver[1] @ $6,500/year	6,500
1 Crewman[1] @ $5,500/year	5,500
TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$ 6,720
Fuel and Maintenance[1]	8,000
TOTAL	$14,720

TOTAL OPERATING COST	$34,720
TOTAL YEARLY COST	48,389
Average monthly collection cost per household	$1.20

---

*Yearly cost includes depreciation and 7% interest cost

**Cost includes miscellaneous tools

[1] Already existing in the system. Packer truck and 50 containers are already bought in the existing system.

[2] A pickup truck from County Highway Department is used in the existing system. This cost is optional.

The county should continue using the Henderson city landfill as the disposal site. The unit disposal cost would be $1.70/ton, the same as is being paid now. The total cost of disposal, according to this plan, would be about $5,500 per year.

TABLE 38

HENDERSON COUNTY

COST SUMMARY

Capital cost of collection	$71,050
Yearly operating cost of collection	48,389
Yearly disposal cost	5,500
TOTAL OPERATING COST	53,889
Average monthly cost of collection and disposal per household	$1.33

4. McLEAN COUNTY

A 24 cubic yard front loading packer truck would serve 43 six cubic yard containers, once a week, in four different routes as shown in Table 39. The container locations in the county, as shown on the county map (see Appendix), would provide the maximum possible service to the residents.

Table 40 shows capital and operating cost of collection. The cost of a pickup truck is optional since the county is using a truck for waste collection in some towns.

The average monthly collection cost per household in this proposed system will be about $2.00. Total capital and operating cost would be about $55,350 and $34,205 per year respectively.

It is recommended that the existing county landfill be used for disposal. The landfill has a dozer and dozer operator. Additional equipment and personnel proposed at the landfill are shown in Table 41.

TABLE 39

MCLEAN COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Lenght of Route (Miles)	Time (Hrs. Min.)	Day
1	11	35	3:00	M
2	12	40	3:30	M
3	10	40	2:30	Th.
4	10	60	4:00	Th.
TOTAL	43	175	15:00	

TABLE 40

McLEAN COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck	24	5	1	$26,000	$26,000	$ 6,341
Containers	6	10	43	450	19,350	2,755
Portable Steam Cleaner	–	10	1	1,500	1,500	214
Portable Spray Painter**	–	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	–	10	1	500	500	70
TOTAL CAPITAL COST					$55,350	$11,027

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year	$ 8,000
1 Driver @ $6,500/year	6,500
1 Crewman @ $5,500/year	5,500
TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$ 6,205
Fuel and Maintenance	8,000
TOTAL	$14,205

TOTAL OPERATING COST	$34,205
TOTAL YEARLY COST	45,232
Average monthly collection cost per household	$2.00

---

*Yearly cost includes depreciation and 7% interest cost.

**Includes miscellaneous tools cost.

TABLE 41

McLEAN COUNTY LANDFILL COST

ADDITIONAL CAPITAL COST

Item	Life (Years)	Total Cost	Yearly Cost*
Scale	20	$ 8,000	$ 752
Shelter	10	4,000	568
Fence	10	1,000	140
Radio Communication Unit	10	500	70
Access Road Improvement	5	1,000	244
TOTAL ADDITIONAL COST		$14,500	$1,774

ADDITIONAL OPERATING COST

Dozer Operation (3 hrs./day, 2 days/week, $2.75/hr.)	$ 858
Scale Operator @ $550/month plus 5.2% FICA	6,312
TOTAL ADDITIONAL OPERATING COST	7,170
TOTAL ADDITIONAL YEARLY COST	8,944

*Includes depreciation and 7% interest cost

TABLE 42

McLEAN COUNTY

COST SUMMARY

Capital cost of collection	$55,350
Additional capital cost of disposal	14,500
TOTAL CAPITAL COST	69,850
Total yearly operating cost of collection	45,232
Total additional yearly operating cost of disposal	8,944
TOTAL ADDITIONAL YEARLY COST OF OPERATION	54,176
Average monthly cost of collection and disposal per household	$2.38

Considering the present operation cost at the landfill, the average monthly cost will increase to about $2.70

5. OHIO COUNTY

A 30 cubic yard front loading packer truck would service 61 six cubic yard containers in four routes, two times a week, as shown in Table 43. The routes and container locations are shown on the county map in the appendix.

The capital and operating cost of collection would be about $67,000 and $34,618 respectively as shown in Table 44. The average monthly cost of collection per household would be about 80c.

This plan recommends the use of the existing county landfill as the disposal site. However, the county has selected a new site in the northern part of the county. The plans for this new landfill are under preparation. It is proposed that the county use this new proposed county landfill for this countywide solid waste system. The present landfill is in good operation. The remaining life of the landfill is about two to three years.

TABLE 43
OHIO COUNTY
COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time* (Hrs. Min.)	Day
1	18	60	3:30	M-Th.
2	17	52	3:25	M-Th.
3	13	64	3:30	T-Fri.
4	13	64	3:25	T-Fri.
TOTAL	61	240	13:50	

*For once-a-week service. The actual figure per week will be double because of the proposed twice-a-week service.

TABLE 44
OHIO COUNTY
COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck	30	5	1	$30,000	$30,000	$ 7,317
Containers	6	10	60	450	27,000	3,844
Portable Steam Cleaner	–	10	1	1,500	1,500	214
Portable Spray Painter**	–	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	–	10	1	500	500	70
TOTAL CAPITAL COST					$67,000	$13,092

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year	$ 8,000
1 Driver @ $6,500/year	6,500
1 Crewman @ $5,500/year	5,500
TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$ 6,618
Fuel and Maintenance	8,000
TOTAL	$14,618

TOTAL OPERATING COST	$34,618
TOTAL YEARLY COST	47,710
Average monthly collection cost per household	$0.80

* Yearly cost includes depreciation and 7% interest cost

**Cost include miscellaneous tools cost

The disposal cost data in this report are for the new proposed site. Since the county has sufficient equipment and personnel to be used at the proposed site, the landfill cost will insure site preparation and additional service cost as shown in Table 45.

TABLE 45

OHIO COUNTY LANDFILL COST

CAPITAL COST

Item	Life (Years)	Total Cost	Yearly Cost*
Scales	20	$ 8,000	$ 752
Shelter	10	6,000	852
Fence	10	1,000	140
Site Preparation	5	1,000	244
Access Road	5	5,000	1,220
Radio Communication Unit	10	500	70
TOTAL CAPITAL COST		$21,500	$3,278

OPERATING COST

Dozer Operation (3 hrs./day, 5 days/week, $2.75 hour)	$ 1,950
Scale Operator ($500 month plus 5.2% FICA)	6,312
TOTAL OPERATING COST	8,262
TOTAL YEARLY OPERATING COST	11,540

*Includes depreciation and 7% interest cost

Table 27 shows the total cost of a new landfill with total need of equipment and personnel. It is recommended that the existing dozer and labor be used at the proposed site.

TABLE 46

OHIO COUNTY

COST SUMMARY

Capital cost of collection	$67,000
Capital cost of disposal	21,500
TOTAL CAPITAL COST	88,500
Yearly operating cost of collection	47,710
Yearly operating cost of disposal	11,540
TOTAL YEARLY OPERATING COST	59,250
Average monthly cost of collection and disposal per household	$1.00

If the existing operating cost of equipment and personnel is considered, the monthly cost per household would be about $1.25.

6. UNION COUNTY

A 30 cubic yard front loading packer truck would serve 44 six cubic yard containers in four routes as shown in Table 47. The container locations and routes are shown on the county map in the appendix.

The capital and operating cost of collection will be $60,250 and $34,426 respectively. Detailed cost breakdown is shown in Table 48.

It is recommended that the county use the proposed Morganfield city landfill site for waste disposal. At a disposal cost of about $1.70 per ton, the county would be paying about $4,000 for disposal.

TABLE 47

UNION COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time (Hrs. Min.)	Day
1	11	40	2:30	M
2	10	38	2:15	M
3	11	46	2:45	Th.
4	12	55	3:30	Th.
TOTAL	44	179	11:00	

TABLE 48

UNION COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck	30	5	1	$30,000	$30,000	$ 7,317
Containers	6	10	45	450	20,250	2,883
Portable Steam Cleaner	–	10	1	1,500	1,500	214
Portable Spray Painter**	–	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	–	10	1	500	500	70
TOTAL CAPITAL COST					$60,250	$12,131

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year	$ 8,000
1 Driver @ $6,500/year	6,500
1 Crewman @ $5,500/year	5,500
TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)	$ 6,426
Fuel and Maintenance	8,000
TOTAL	$14,426

TOTAL OPERATING COST	$34,426
TOTAL YEARLY COST	$46,557
Average monthly collection cost per household	$1.76

---

* Yearly cost includes depreciation and 7% interest cost

** Includes miscellaneous tools cost

TABLE 49

UNION COUNTY

COST SUMMARY

Capital cost of collection	$60,250
Operating cost of collection (Yearly)	46,557
Yearly disposal cost	4,000
TOTAL OPERATING COST	$50,557
Annual average cost of collection and disposal per household	$2.00

7. WEBSTER COUNTY

A 24 cubic yard front loading packer truck would service 46 six cubic yard containers in four routes as shown in Table 50.

Two workdays of eight hours each are proposed for this service. The county may wish to provide this service in three days using the extra day for route 3 or 4. The container locations and routes are shown on the county map in the appendix. The capital and operating cost would be about $56,700 and $34,243 respectively. The average monthly cost of collection per household would be approximately $2.00.

There is no existing county disposal site. It is recommended that the county use the John Collins landfill located near Wheatcroft for the waste disposal. This site is well operated and large enough to take the additional waste load. This would save the county the capital and operating cost of a new landfill. The disposal cost at this proposed private landfill would be about $3,500 at $1.70 per ton.

TABLE 50

WEBSTER COUNTY

COLLECTION ROUTE

Route No.	No. of Containers	Length of Route (Miles)	Time (Hrs. Min.)	Day
1	12	35	3:15	M
2	10	20	2:30	Th.
3	12	55	4:30	Th.
4	12	52	4:30	M
TOTAL	46	162	14:45	

TABLE 51

WEBSTER COUNTY

COLLECTION COST

CAPITAL COST Item	Size (Cu.Yd.)	Life (Years)	No.	Unit Cost	Total Cost	Yearly Cost*
Front Loading Packer Truck	24	5	1	$26,000	$26,000	$ 6,341
Containers	6	10	46	450	20,700	2,947
Portable Steam Cleaner	–	10	1	1,500	1,500	214
Portable Spray Painter**	–	10	1	3,000	3,000	428
Pickup Truck	2 ton	5	1	5,000	5,000	1,219
Radio Communication Unit	–	10	1	500	500	70
TOTAL CAPITAL COST					$56,700	$11,219

OPERATING COST

Salaries:

1 Supervisor @ $8,000/year		$ 8,000
1 Driver @ $6,500/year		6,500
1 Crewman @ $5,500/year		5,500
	TOTAL	$20,000

Administrative and Maintenance Cost:

Administrative Contingency (20%)		$ 6,243
Fuel and Maintenance		8,000
	TOTAL	$14,243

TOTAL OPERATING COST	$34,243
TOTAL YEARLY COST	45,462
Average monthly collection cost per household	$2.00

---

*Yearly cost includes depreciation and 7% interest cost

**Includes miscellaneous tools cost

TABLE 52

WEBSTER COUNTY

COST SUMMARY

Capital cost of collection	$36,700
Yearly operating cost of collection	45,462
Yearly disposal cost	3,500
TOTAL YEARLY OPERATING COST	$48,962
Average monthly cost of collection and disposal per household	$2.10

appendix

1. Operating and Maintenance Record Forms
2. Regional Soils Map
3. Waste Collection Routes

MONTHLY EQUIPMENT MAINTENANCE REPORT

SITE: ____________ PERIOD: from ________ to ________

EQUIP. IDENT.: ____________ Person in charge ____________

Day	Hours Operated	Fuel Cost	Maintenance						
			Type of repair or service	Hours down	Labor hours	Labor cost	Parts cost	External cost	Total cost
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
Totals			XXXX						

Entries under maintenance should be made only as they occur. This sheet is only for one piece of equipment.

SOURCE: **An Accounting System for Sanitary Landfill Operations,** EPA, Bureau of Solid Waste Management, 1969

COLLECTION SYSTEM RECORD

County: ______________________ Date: ______/______/______

Supervisor: ______________________

(1) Route	(2) Truck No.	(3) No. of Crew on Truck	(4) Collection Point	(5) Distance (Miles)	(6) Average Speed (mph)	(7) Travel Time (Min.)	(8) No. of Containers	(9) Amount of Waste Collected	(10) Container Collection Time (Min.)	(11) Total Time (Min.)	(12) Labor Efficiency	(13) Remarks / Down Time

Column

(3) Identify number of crew on the truck including driver.
(4) Identify collection point by letter or number.
(5) Distance between collection points in miles.
(6) Average speed of travel between collection points.
(7) [Column (5) ÷ Column (6)] x 60.
(9) Waste volume in tons collected derived from scales at the disposal site or estimate of cu. yd. compacted waste in the truck.
(10) Total time that collection vehicle is on container site.
(11) Column (7) + Column (10).
(12) Column (9) ÷ Column (3) x Column (11) ______________ tons/labor hours.
(13) Remaks about spillage, down time, etc.

LANDFILL OPERATING COST REPORT

SITE: ____________________ PERIOD OF REPORT: from __________ to __________

	Data	Actual this period	% var from budget	% var. from last period	% vra. this period last year
Totals	Total tons received				
	Total operating cost				
	Total operating cost/ton				
Unit costs*	Labor/ton				
	Cover material/ton				
	Equip. operation/ton				
	Overhead/ton				
Efficiency factors*	Cover material util.				
	Overtime hours/total labor hours				
	Labor efficiency				
	Equip. % downtime				
	Equipment utilization				
	Equipment efficiency				

Instructions: To be completed by accounting department. One copy to landfill supervisor.

*Calculations: Unit cost = aggregate cost ÷ tons solid waste received. Note that cover material unit cost is cover material cost ÷ tons of solid waste received.

Cover material utilization = cover material used ÷ tons of solid waste received.

Equipment utilization = tons received ÷ equipment hours.

Labor efficiency = tons received ÷ labor hours.

Equipment efficiency = equipment cost ÷ equipment hours.

Equipment % downtime = total hours down ÷ total equipment hours.

Source: **An Accounting System for Sanitary Landfill Operations**, EPA, Bureau of Solid Waste Management, 1969

DAILY TRUCK WEIGHT RECORD

SITE: ______________________ DATE: ____/____/____

SIGNATURE: ______________________

TRUCK IDENT.	TIME*	WASTES		WEIGHT IN	WEIGHT OUT (TARE WEIGHT)	AMOUNT DELIVERED
		SOURCE†	TYPE‡			SOLID WASTE
TOTALS	X	X	X	X	X	

Instructions: To be completed by weighmaster for each truck, each time it makes a delivery. If scales are not available, an estimate of cubic yards is acceptable.

* Only record time at 15-minute intervals.

† Sources: R = residential, I = Industrial, C = commerical, A = agricultural, etc.

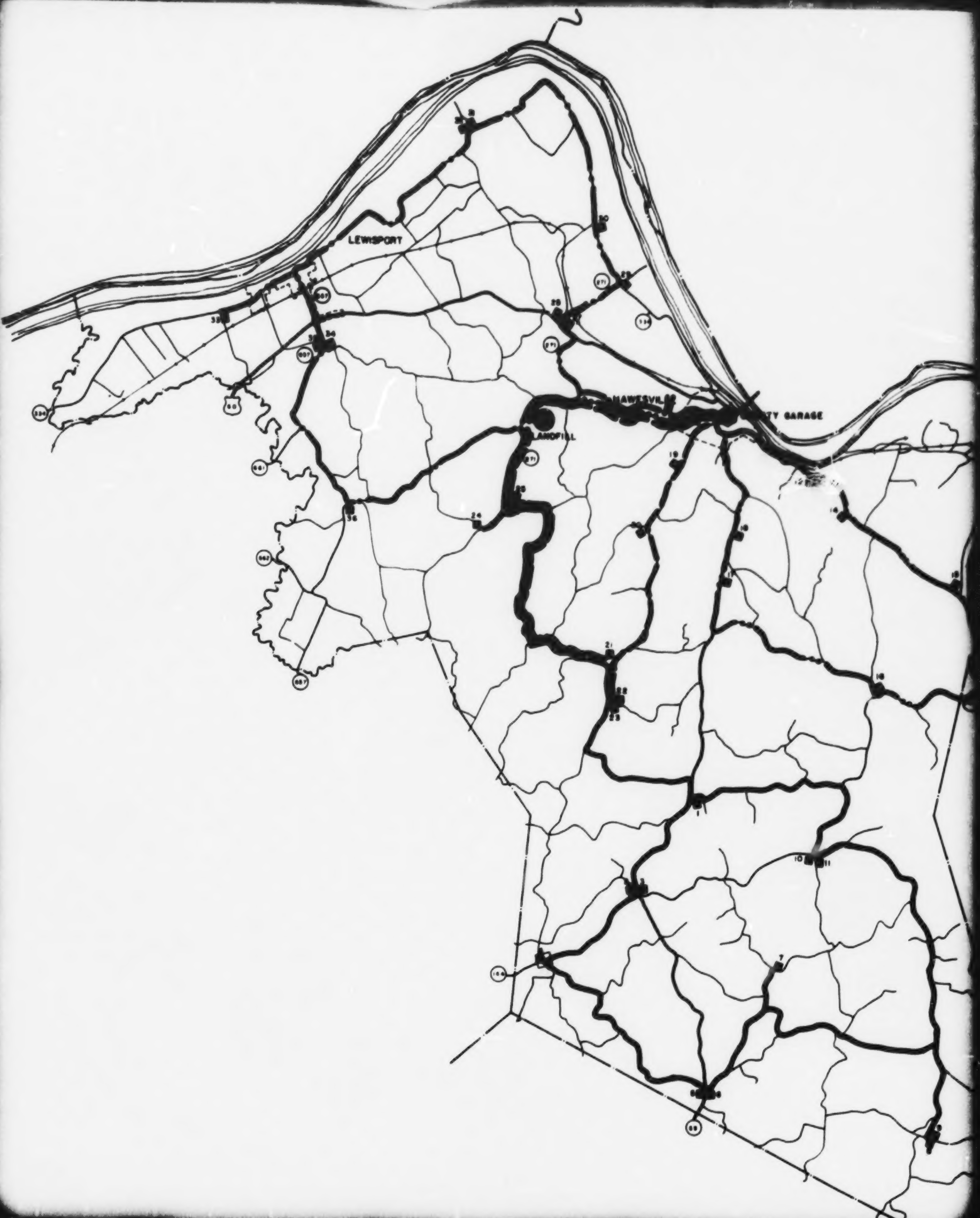
‡ Types: H = household refuse, D = demolition/construction wastes, T = tires, B = bulky waste – furniture, refrigerators, etc.

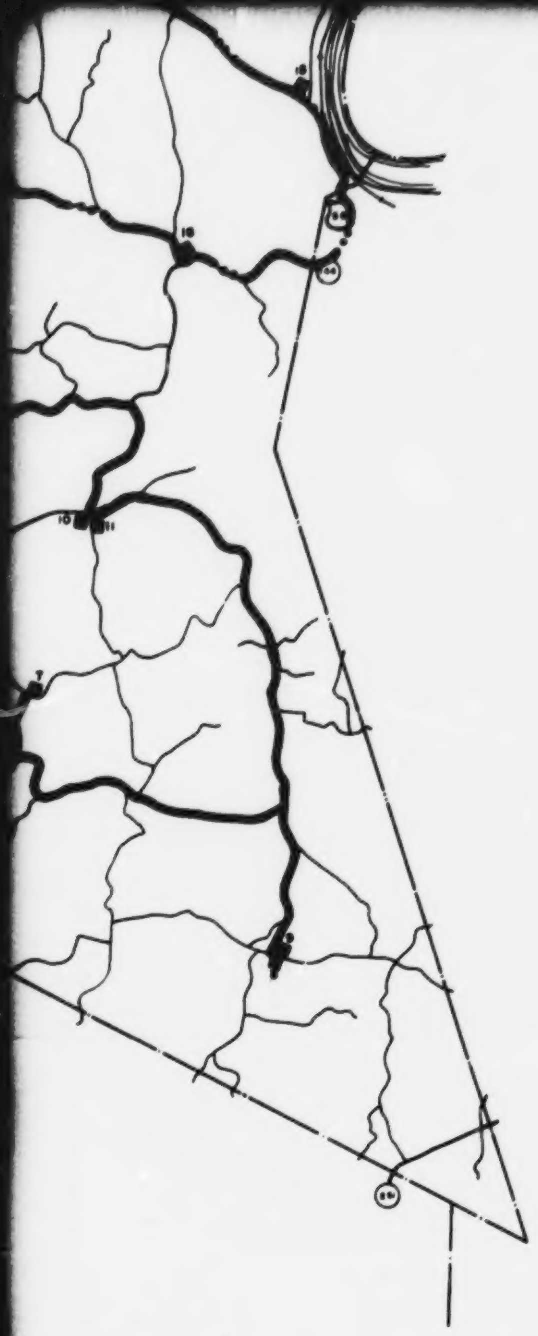
SOURCE: **An Accounting System for Sanitary Landfill Operations**, EPA, Bureau of Solid Waste Management, 1969.

HANCOCK COUNTY COLLECTION SYSTEM

ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME HR MIN	DAY	SYMBOL
1	11	45	3 00	MONDAY	━━━━━
2	7	28	2 00	MONDAY	━━━·━━
3	7	20	2 00	THURSDAY	━ ━ ━
4	11	35	3 00	THURSDAY	━━·━━

LANDFILL ● COUNTY GARAGE ⬢ CONTAINERS ■


LEWISPORT
HAWESVILLE
TY GARAGE
LANDFILL
271
271
271
334
60
657
657
661
662
104
69
19
18
16
13
21
22
23
24
26
28
30
33
34
36
1
7
10
11



HANCOCK COUNTY

SCALE

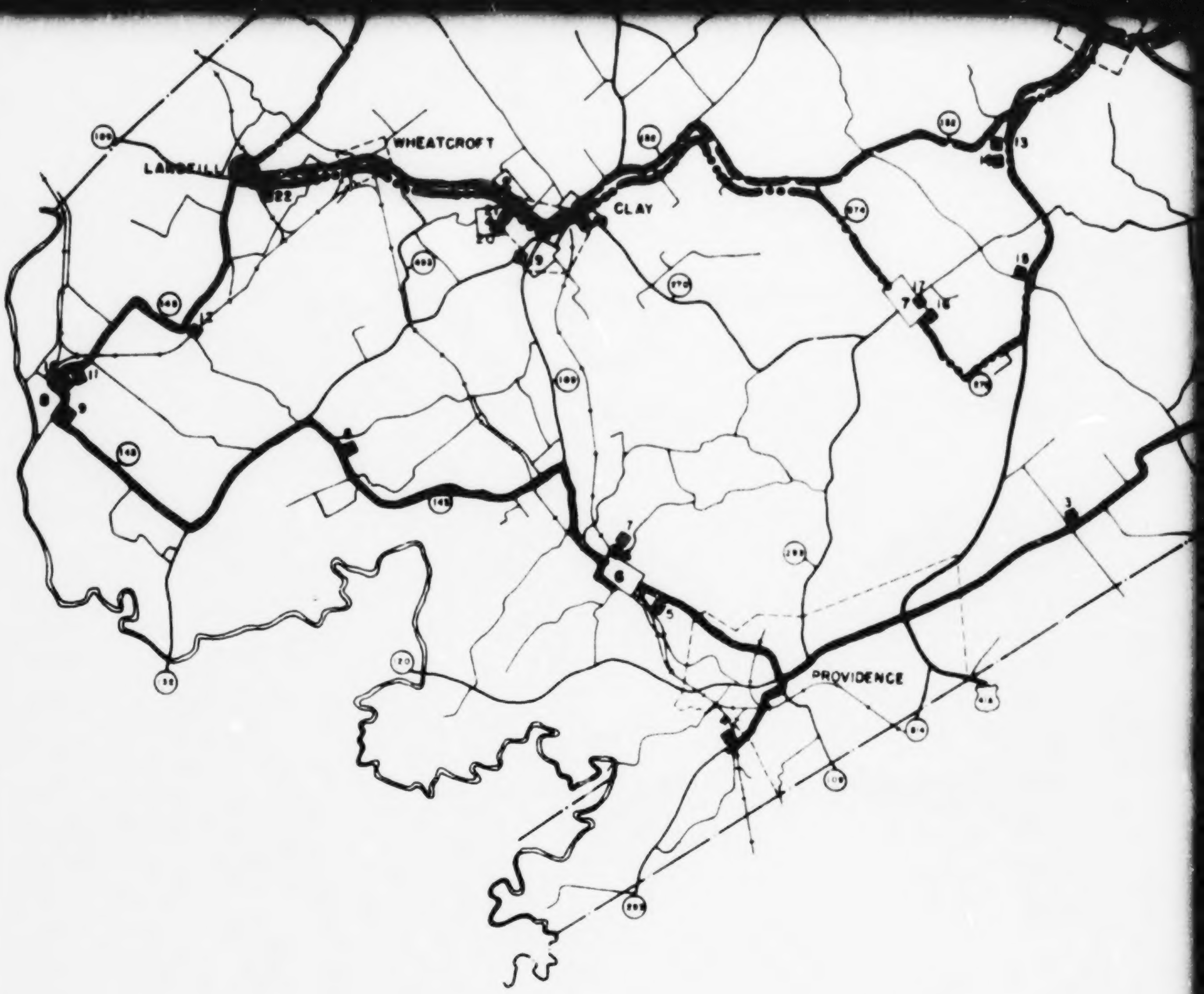
0 1 2 3 4 MILES

PREPARED FOR:

GREEN RIVER AREA DEVELOPMENT DISTRICT

PREPARED BY:

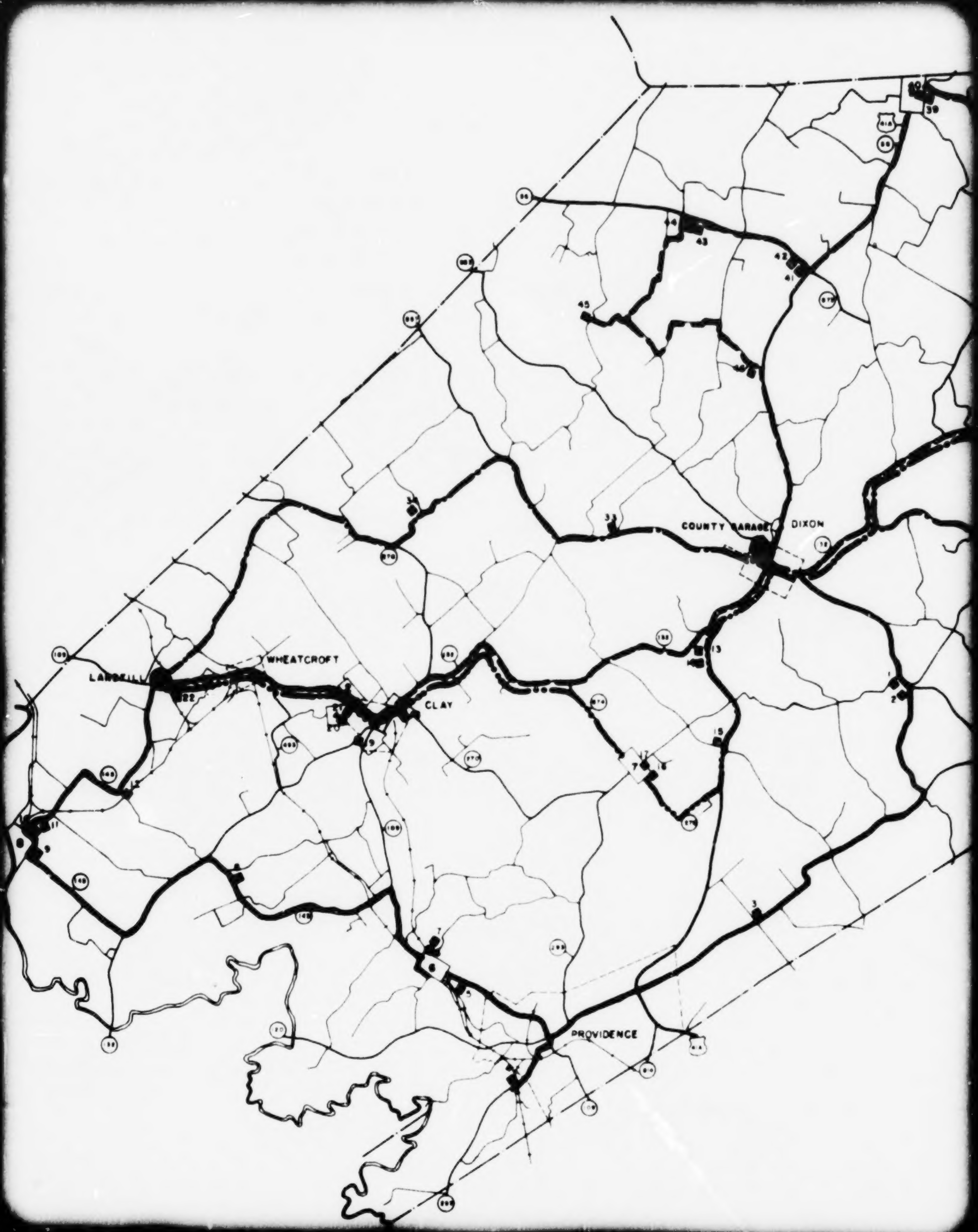
JOHNSON, DEPP, & QUISENBERRY 1972


LANDFILL
WHEATCROFT
CLAY
PROVIDENCE
109
132
120
148
270
874
293
41A
814
22
13
16
17
18
3
5
6
7
9
11
12

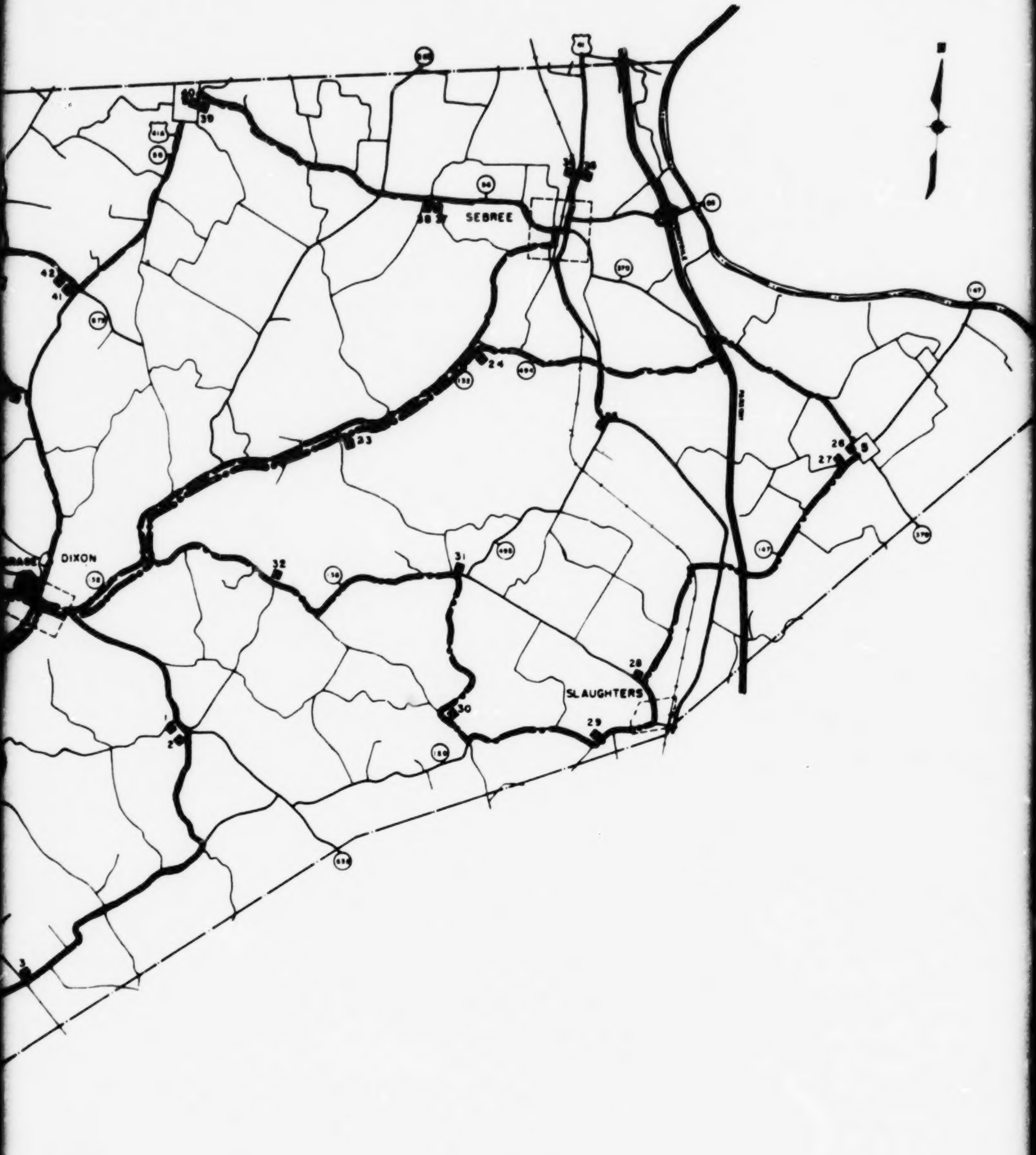
WEBSTER COUNTY COLLECTION SYSTEM

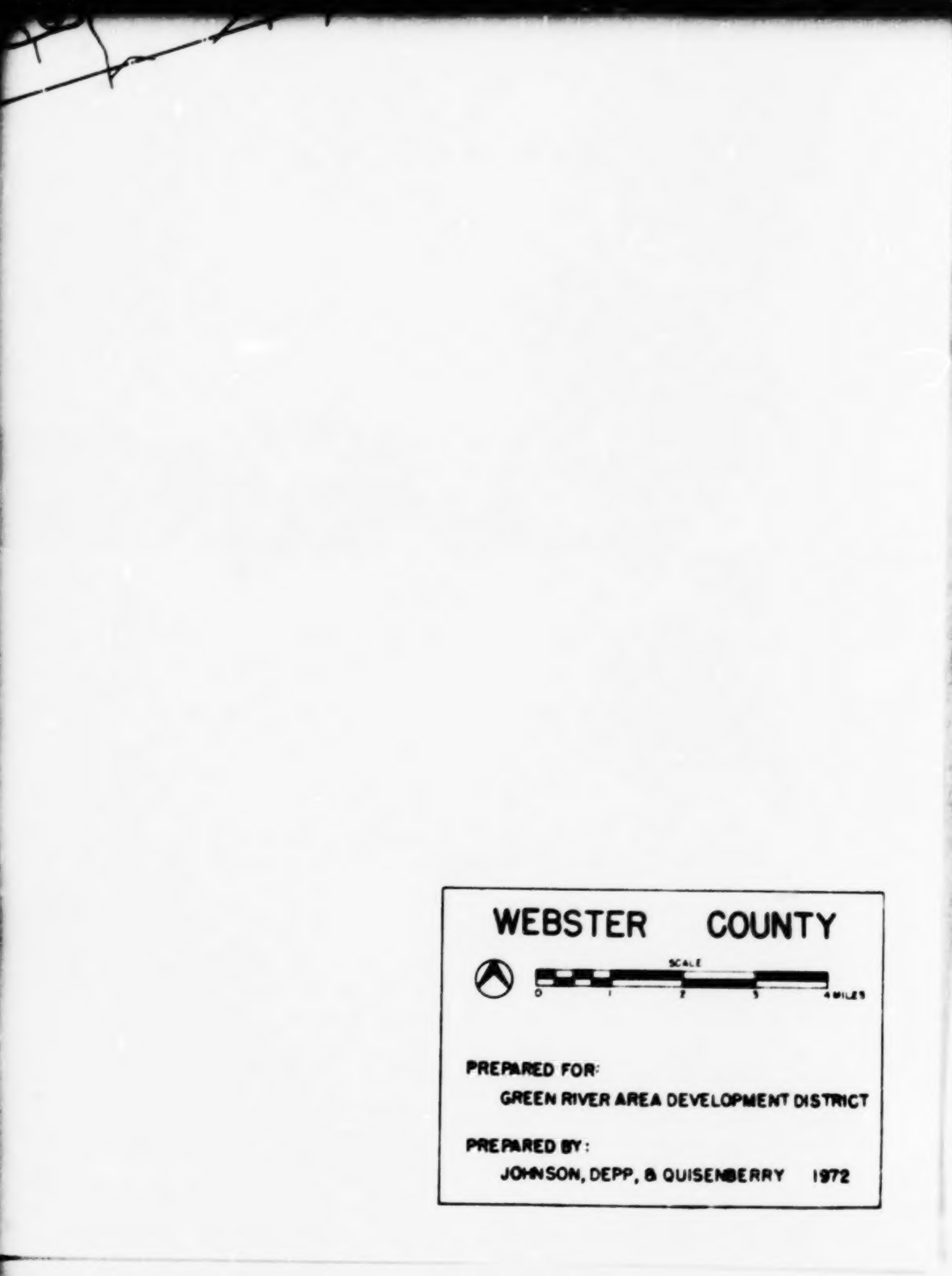
ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME HR· MIN·	DAY	SYMBOL
1	12	35	3 15	MONDAY	━━━━
2	10	20	2 30	THURSDAY	━━•━━
3	12	55	4 30	THURSDAY	━━•━━
4	12	52	4 30	MONDAY	━━ ━━

LANDFILL ● COUNTY GARAGE ⬢ CONTAINERS ■



COUNTY GARAGE
DIXON
LANDFILL
WHEATCROFT
CLAY
PROVIDENCE
122
1
2
3
5
6
7
9
11
12
13
15
17
18
20
33
34
39
40
41
42
43
44
45

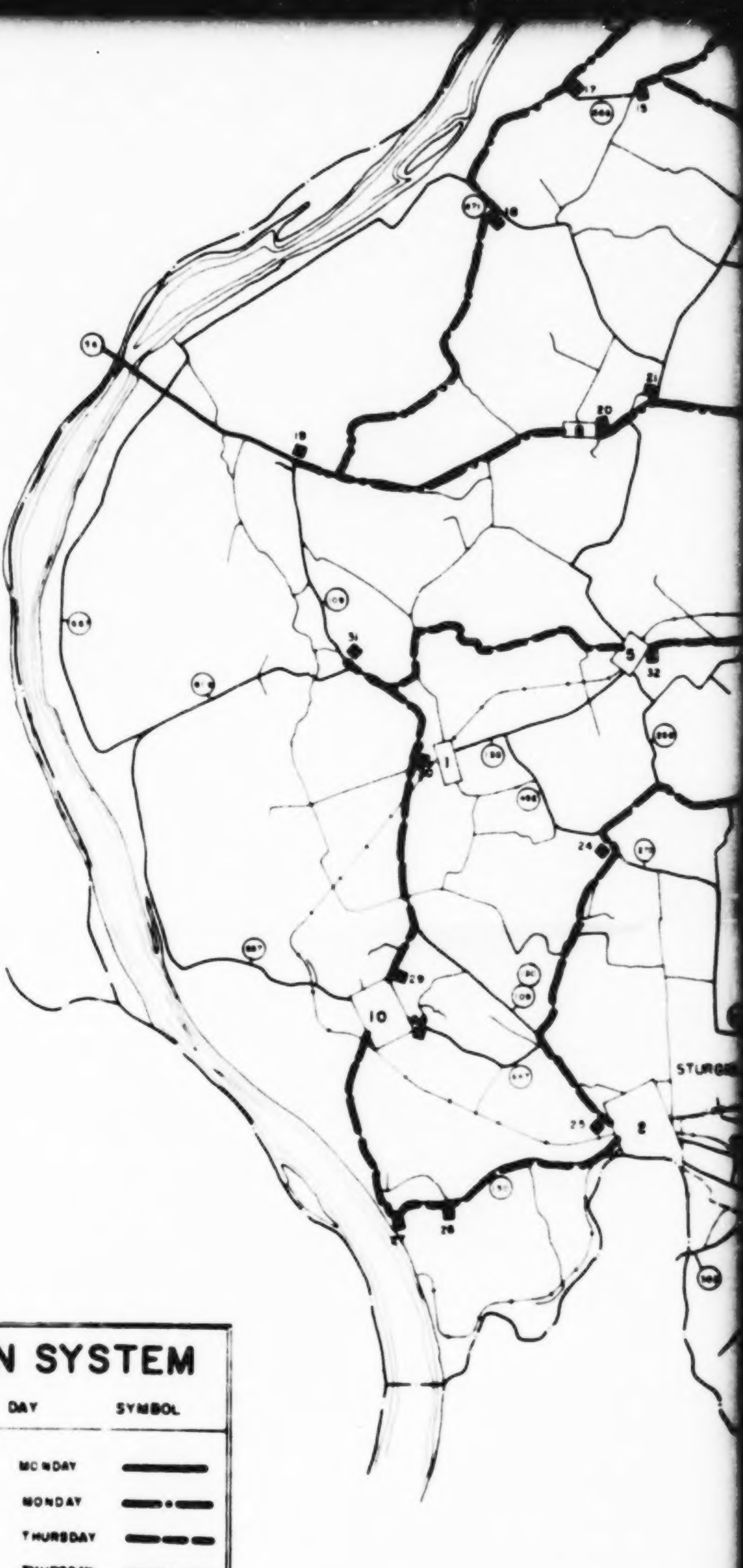

40
39
38 37
SEBREE
36
42
41
24
23
DIXON
32
31
26
27
28
SLAUGHTERS
29
30
1
2
3


SCALE
0
1
2
3
4 MILES

WEBSTER COUNTY

PREPARED FOR:
GREEN RIVER AREA DEVELOPMENT DISTRICT

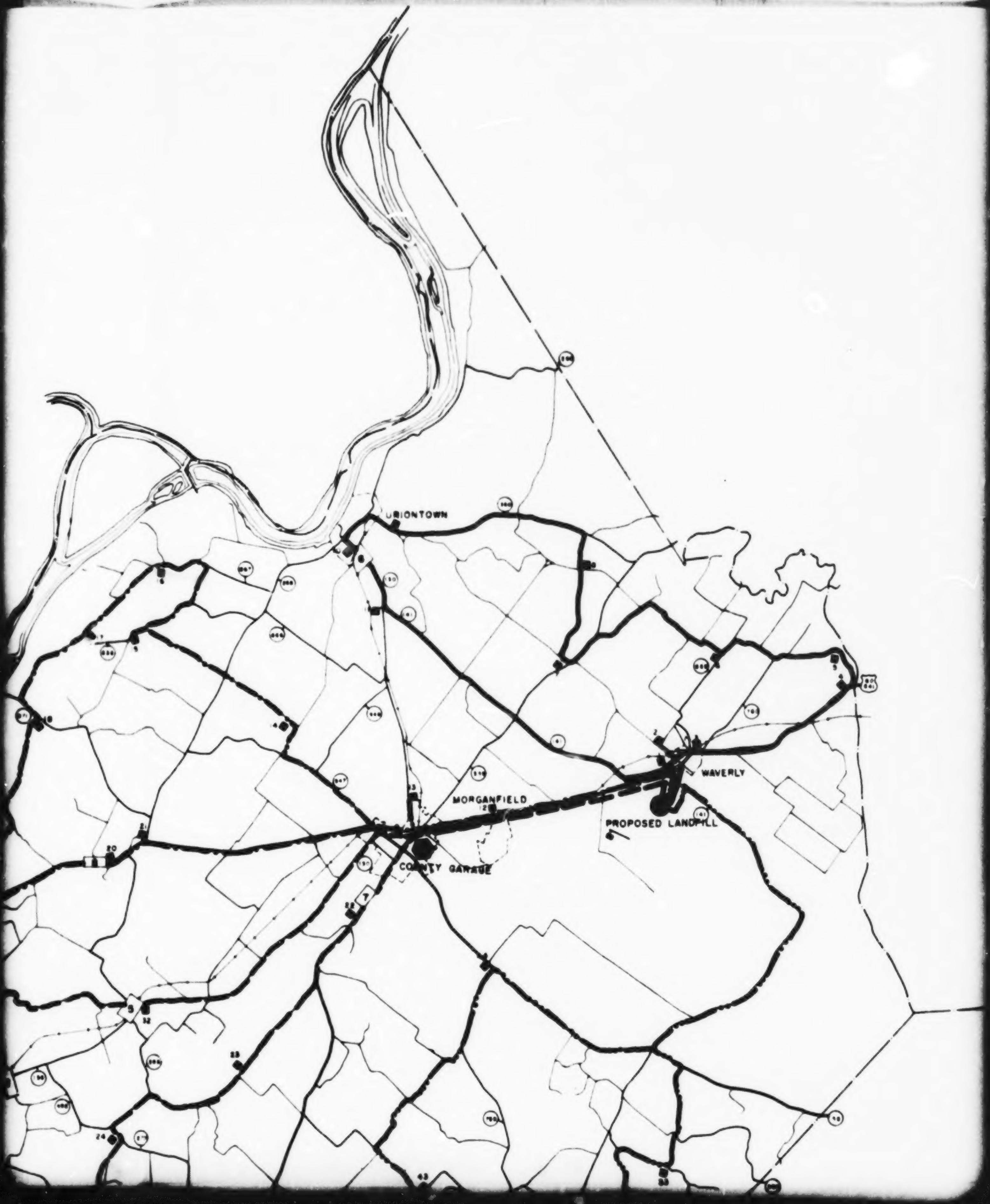
PREPARED BY:
JOHNSON, DEPP, & QUISENBERRY 1972

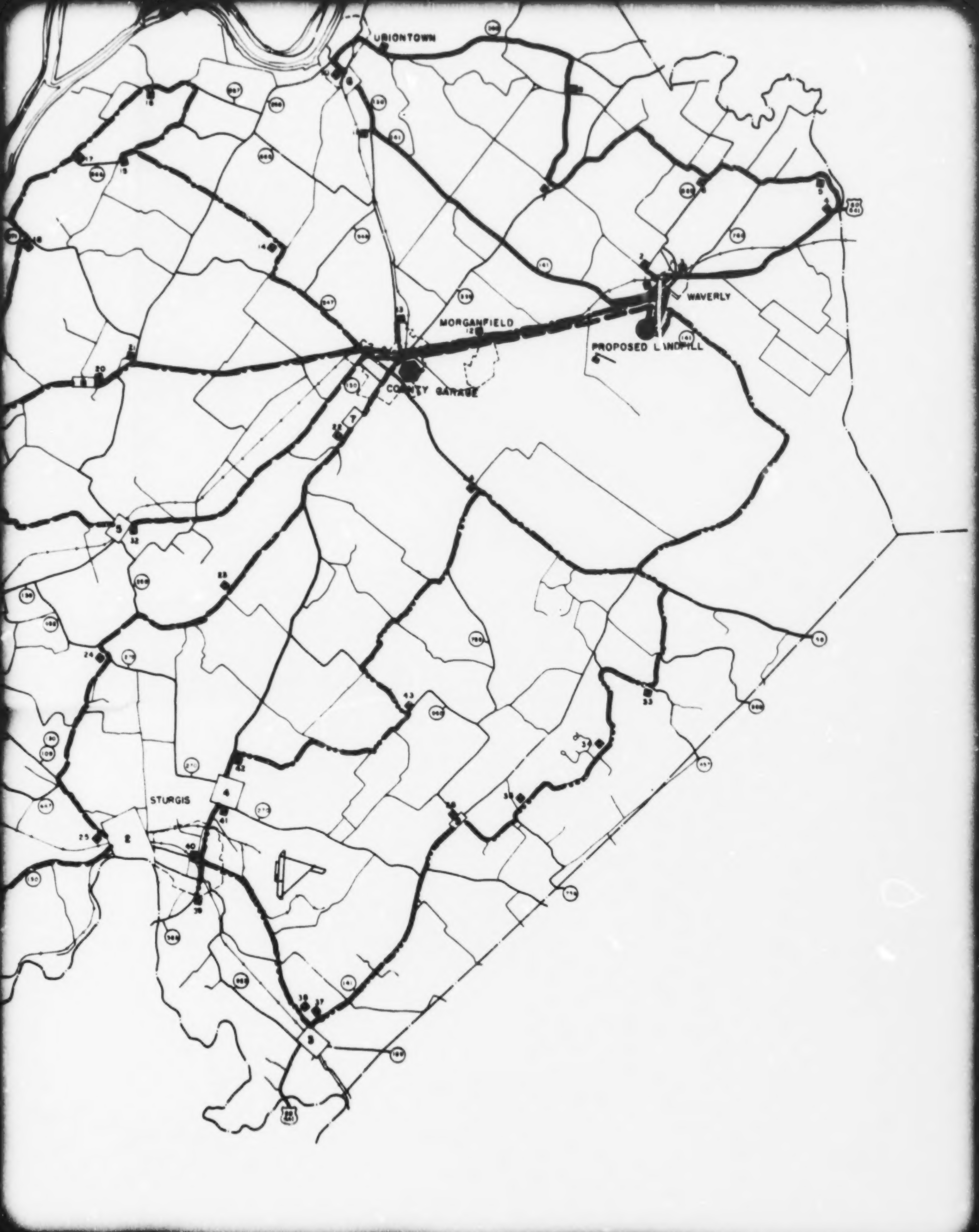


UNION COUNTY COLLECTION SYSTEM

ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME HR MIN	DAY	SYMBOL
1	11	40	2 30	MONDAY	━━━━
2	10	38	2 15	MONDAY	━━•━━
3	11	46	2 45	THURSDAY	━━ ━━ ━
4	12	55	3 30	THURSDAY	━━••━━

LANDFILL ● COUNTY GARAGE ⬢ CONTAINERS ■


UNIONTOWN
130
141
MORGANFIELD
WAVERLY
PROPOSED LANDFILL
COUNTY GARAGE
141
56
2
20
21
22
23
24
43


UNIONTOWN
MORGANFIELD
WAVERLY
PROPOSED LANDFILL
COUNTY GARAGE
STURGIS
1
2
3
4
5
6
7

UNION COUNTY

SCALE

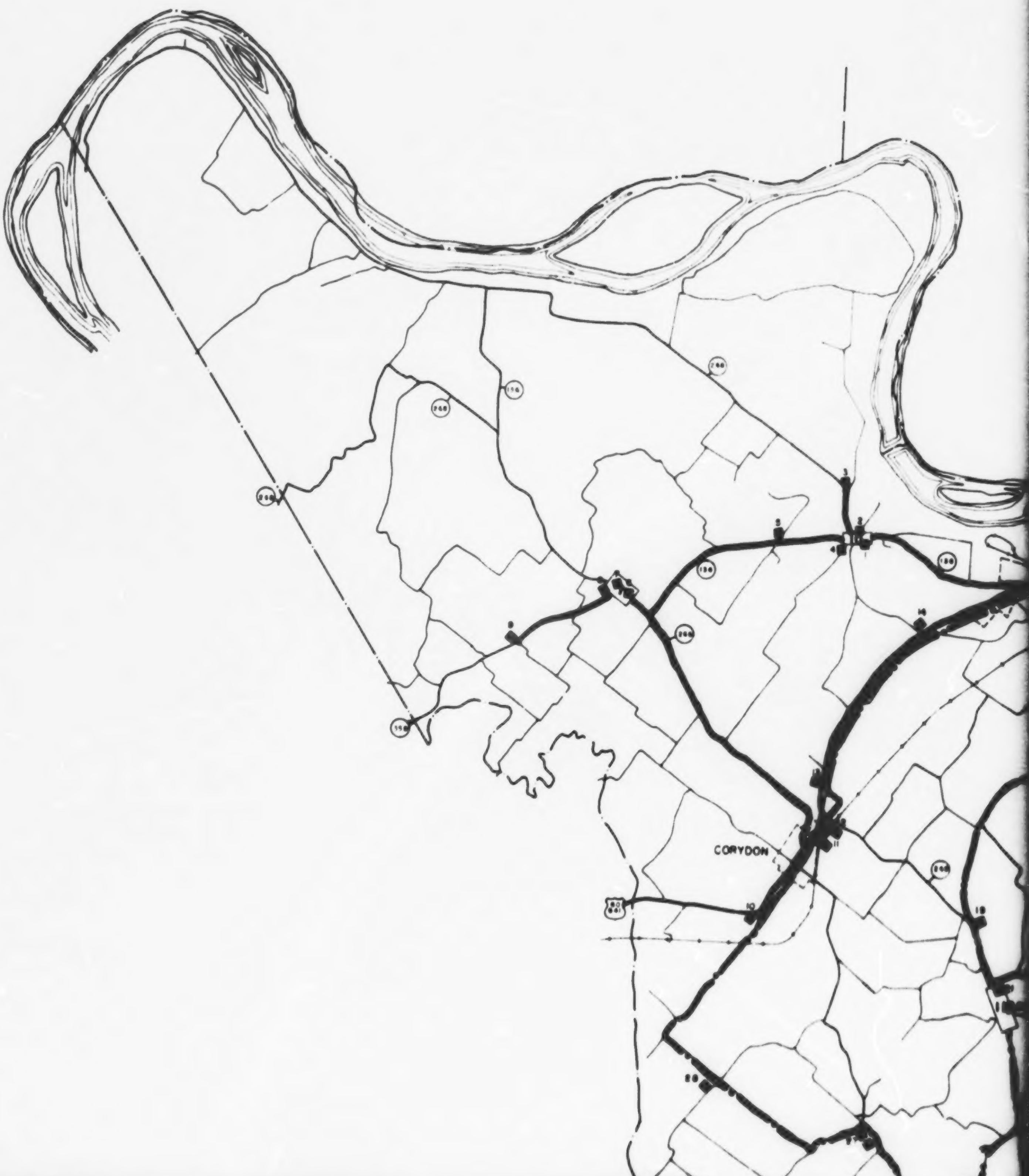
0 1 2 3 4 MILES

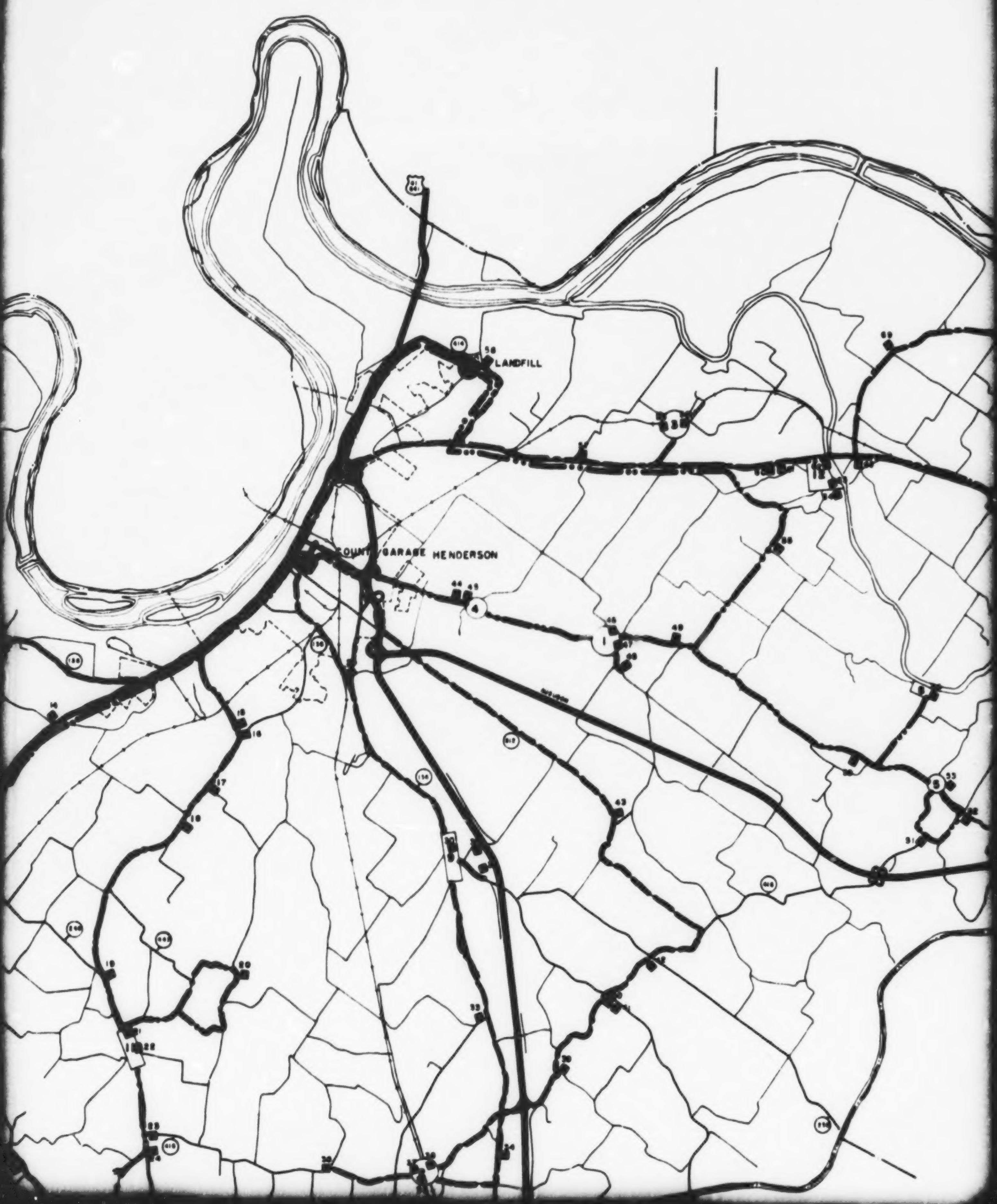
PREPARED FOR:

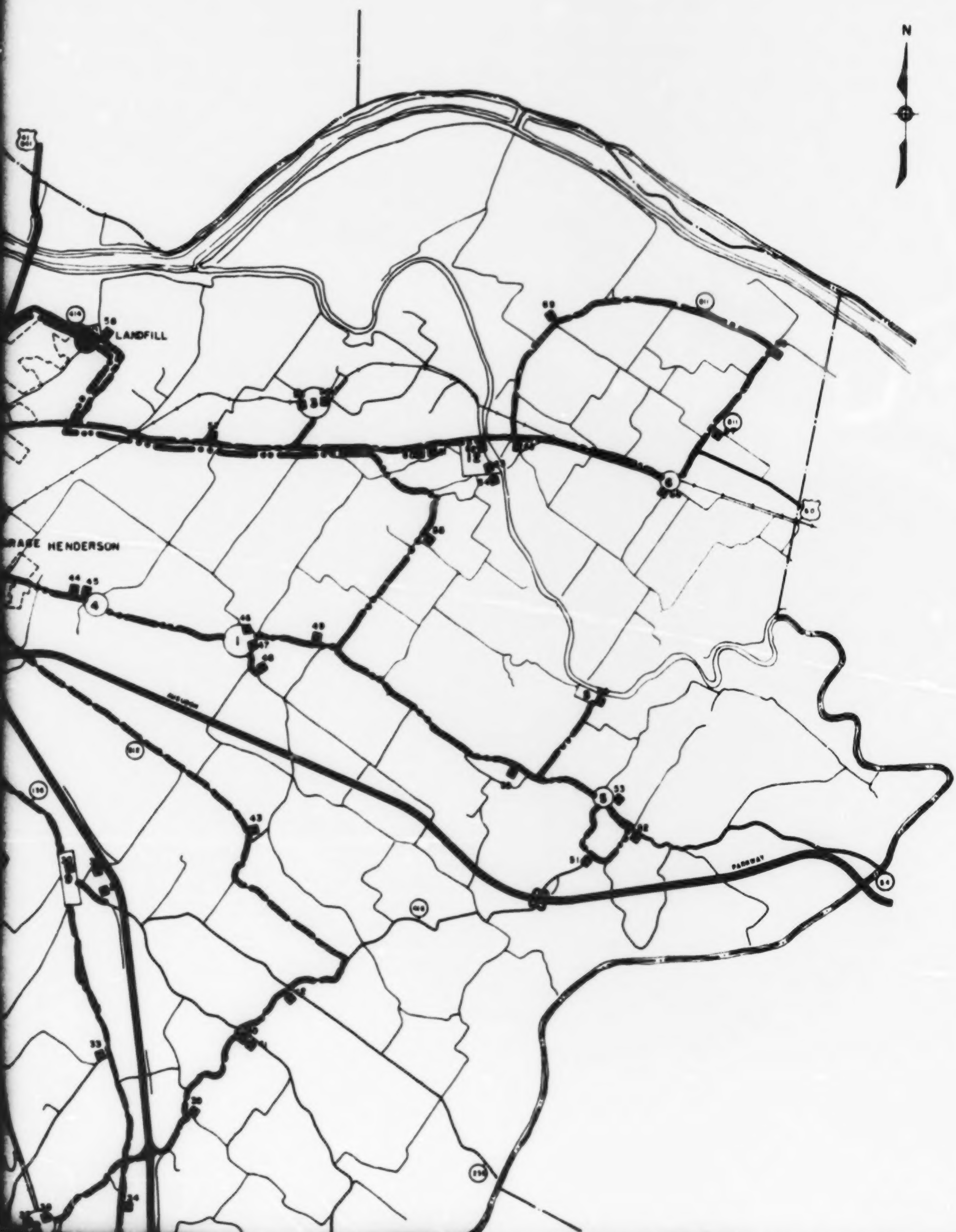
GREEN RIVER AREA DEVELOPMENT DISTRICT

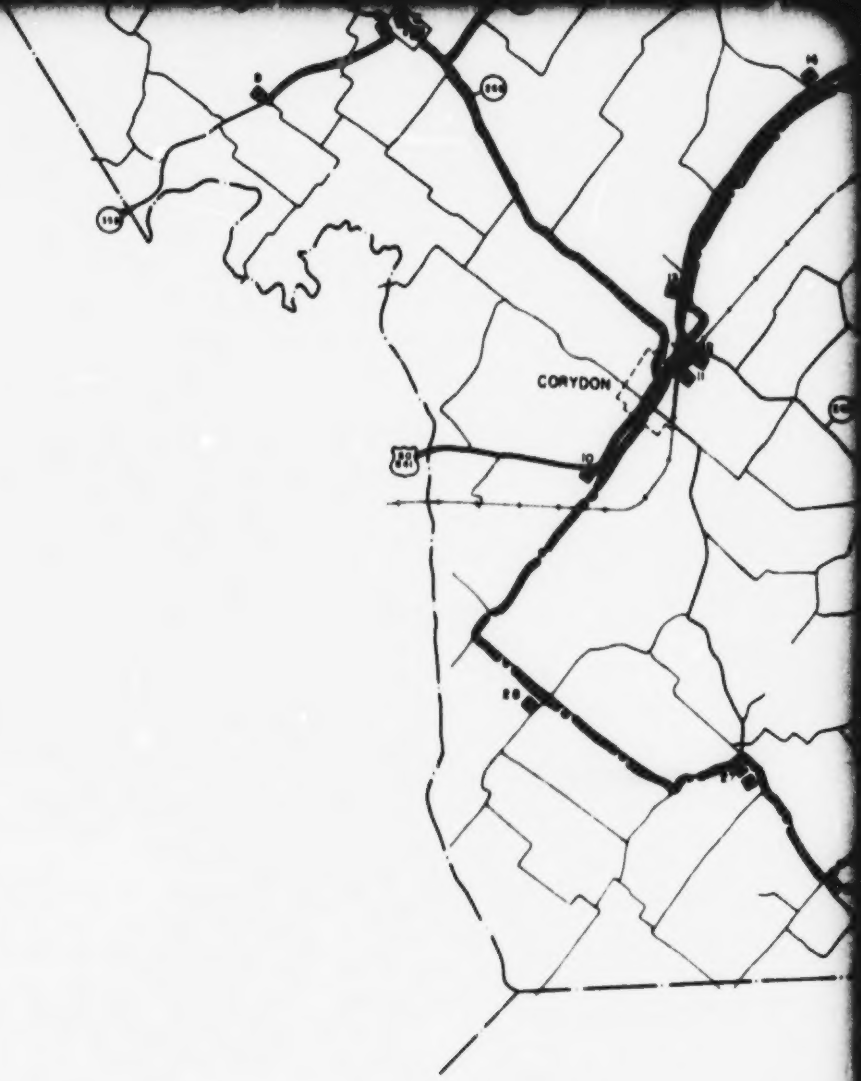
PREPARED BY:

JOHNSON, DEPP, & QUISENBERRY 1972


CORYDON
8
5
3
2
4
1
14
11
10
19
20


414
58
LANDFILL
COUNTY GARAGE
HENDERSON
4
1
5

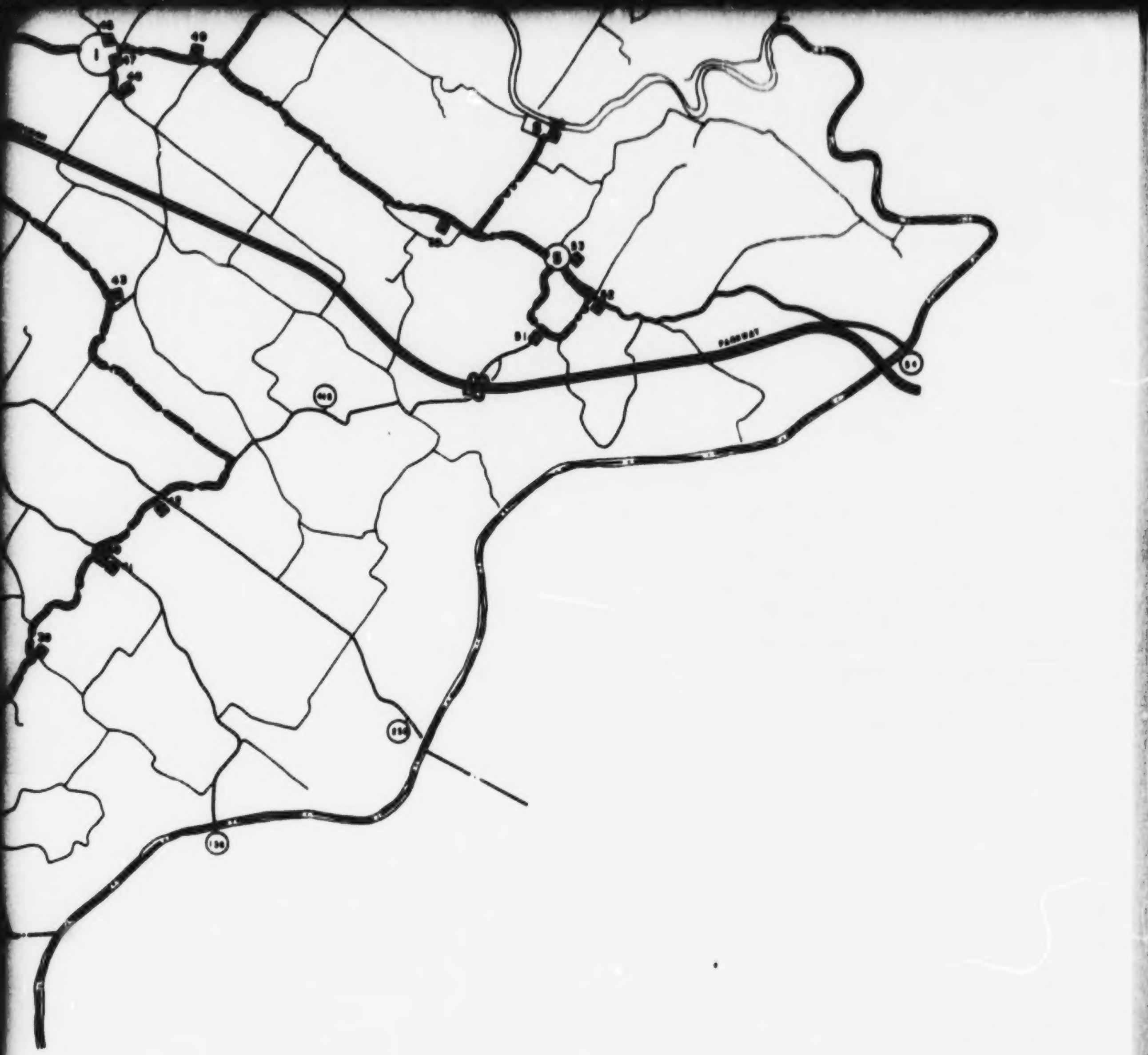

N
414
58
LANDFILL
59
811
811
6
60
HENDERSON
44
45
4
46
1
47
48
49
53
5
52
51
43
PARKWAY
64
33
34



HENDERSON COUNTY COLLECTION SYSTEM

ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME HR MIN	DAY	SYMBOL
1	14	38	2 45	MONDAY	━━━━━
2	14	52	3 00	TUESDAY	━━ • ━━
3	15	40	3 30	WEDNESDAY	━━ • • ━━
4	12	40	3·00	THURSDAY	━ ━ • ━ ━
5	14	38	3 15	FRIDAY	━ ━ ━

LANDFILL ● COUNTY GARAGE ⬢ CONTAINERS ■



HENDERSON COUNTY

SCALE

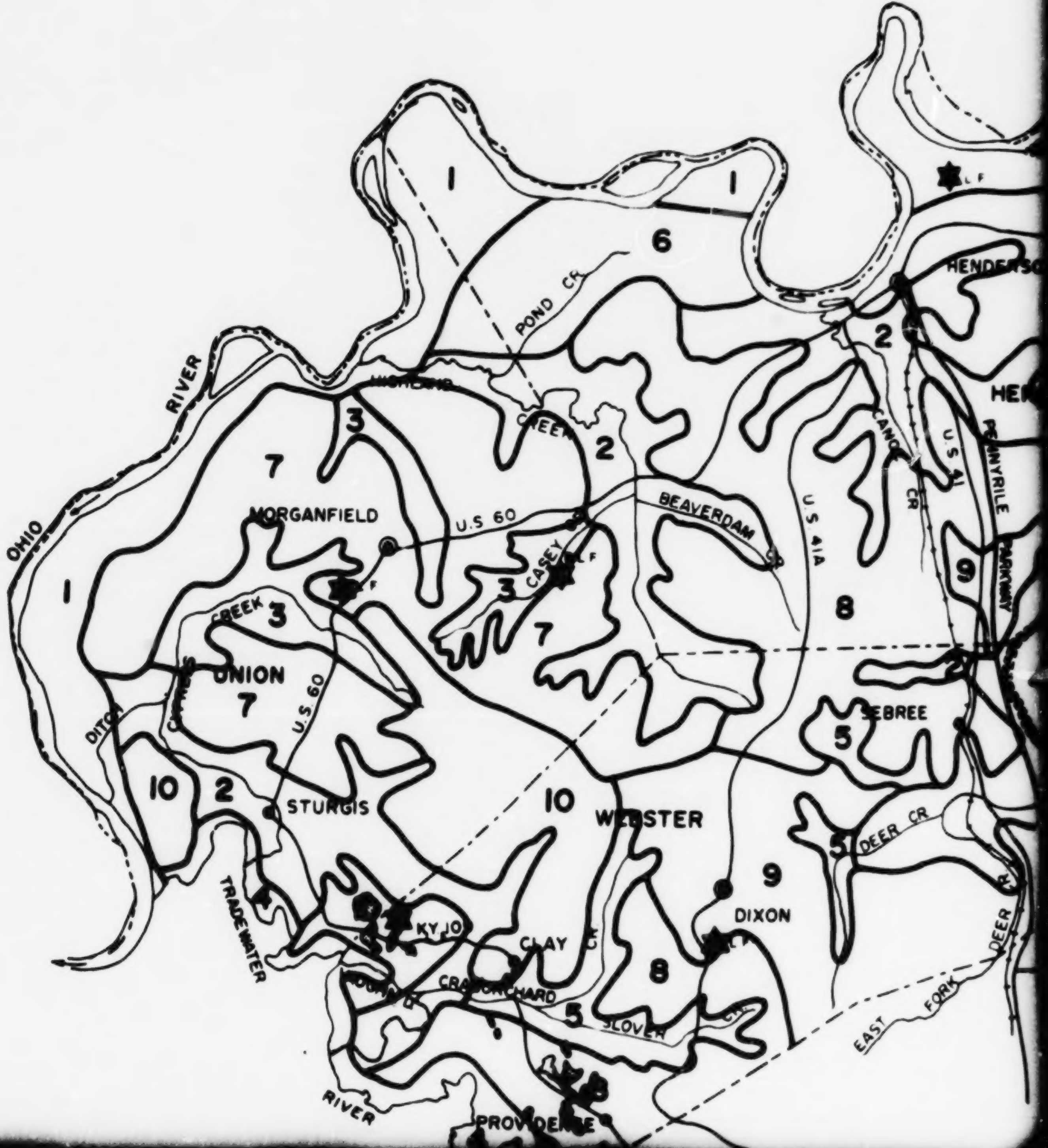
0 1 2 3 4 MILES

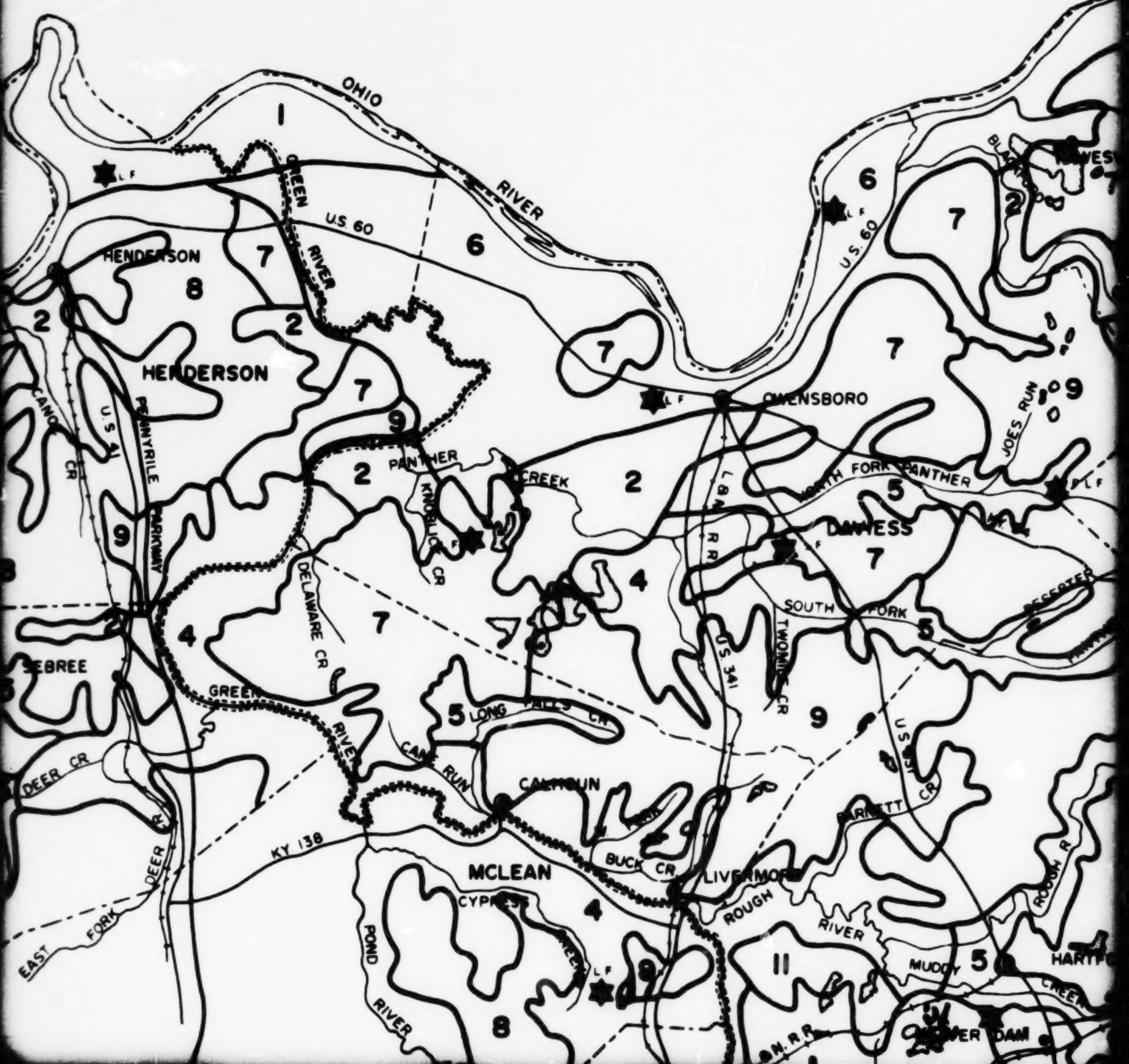
PREPARED FOR:

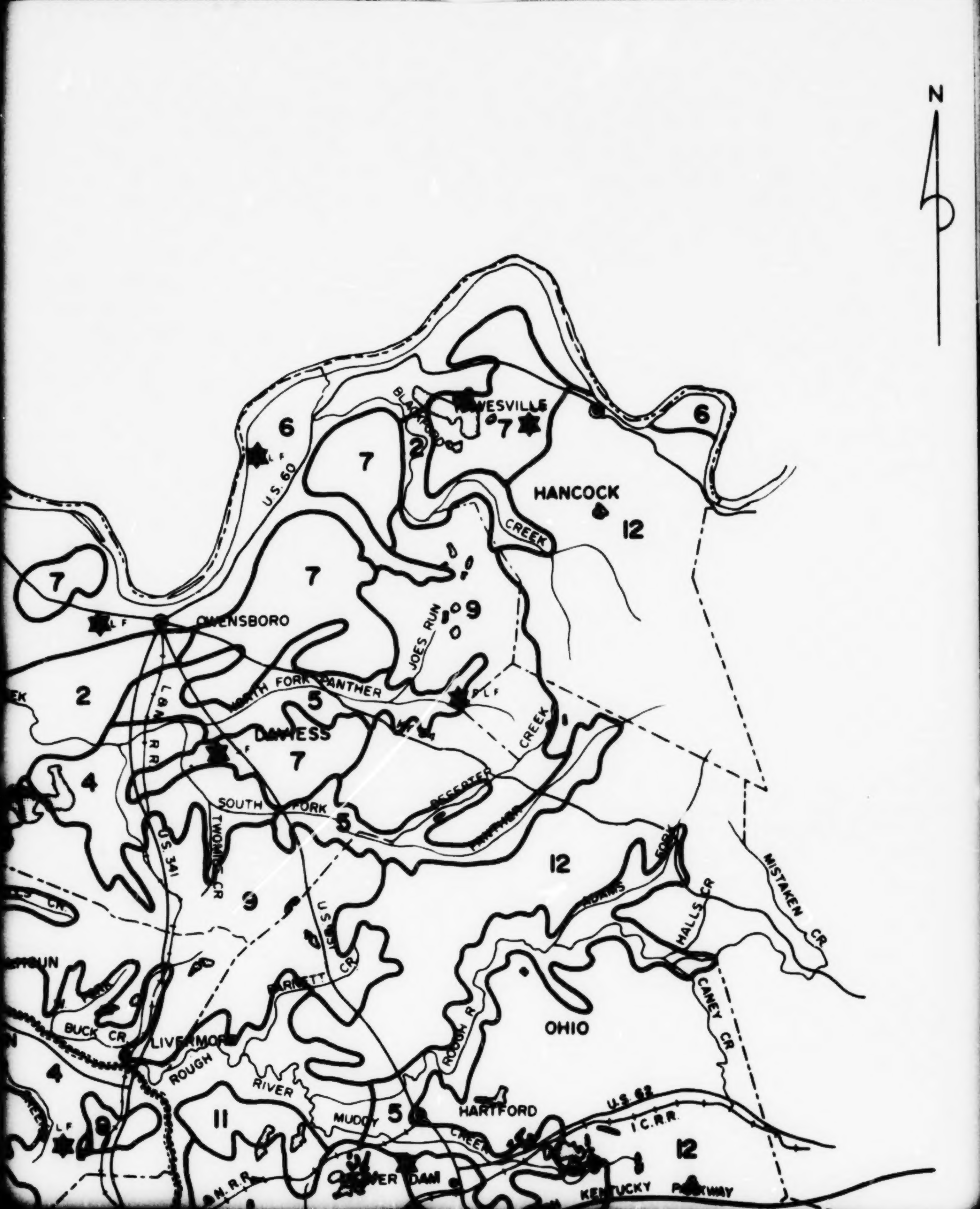
GREEN RIVER AREA DEVELOPMENT DISTRICT

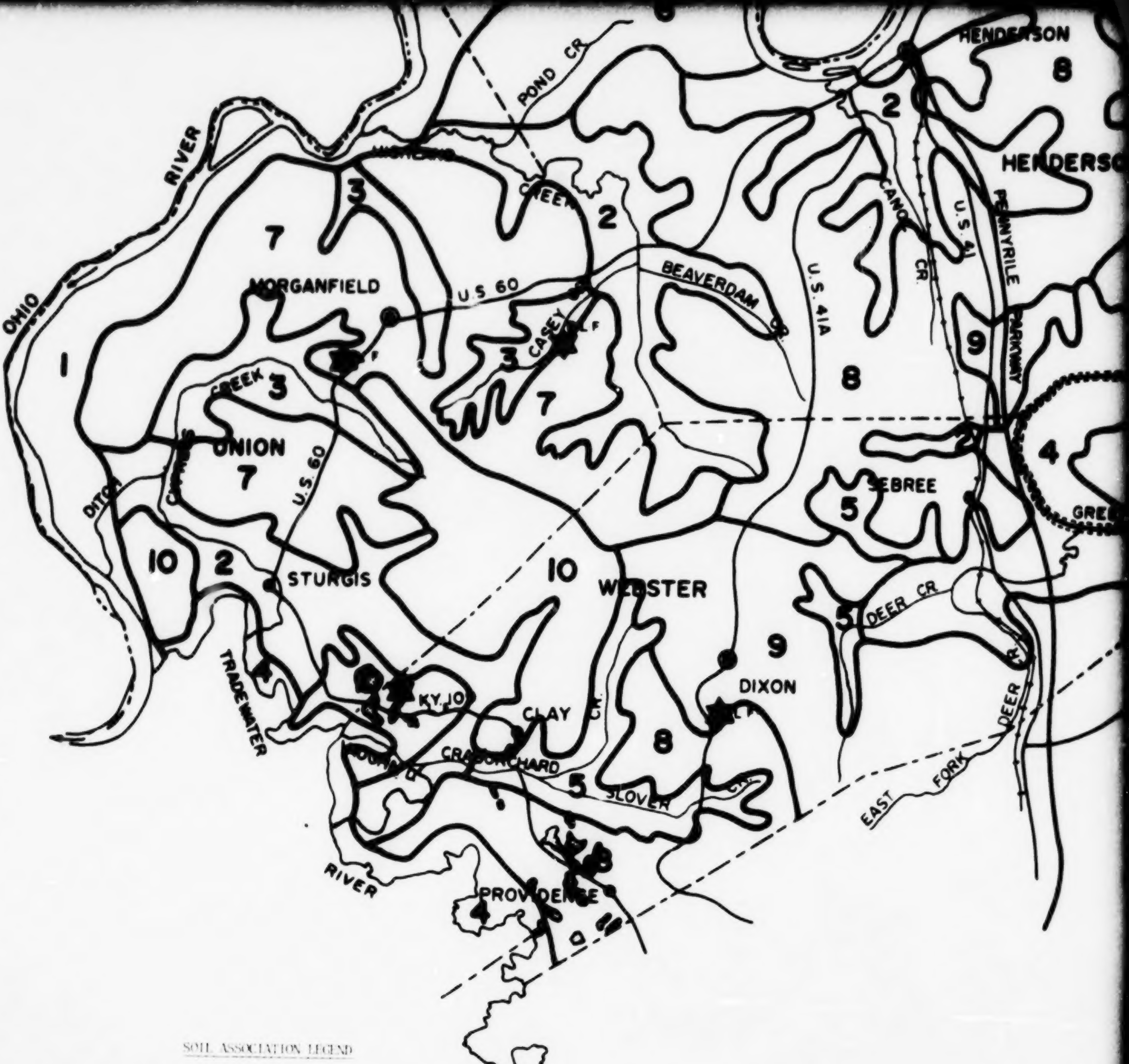
PREPARED BY:

JOHNSON, DEPP, & QUISENBERRY 1972


OHIO
RIVER
1
1
1
6
HENDERSO
POND CR
2
HIGHLAND
CREEK
3
7
2
HEN
CANOE CR
U.S. 41
PENNYRILE PARKWAY
L.F
MORGANFIELD
U.S. 60
BEAVERDAM
U.S. 41A
CASEY
L.F
3
7
9
8
CREEK
3
L.F
UNION
7
CYPRESS
DITCH
U.S. 60
SEBREE
5
10
2
STURGIS
10
WEBSTER
DEER CR
5
9
TRADEWATER
KY 10
DIXON
L.F
CLAY
CR
8
DEER
CR
CRAB ORCHARD
MOUND
5
SLOVER
CR
EAST FORK
RIVER
PROVIDENCE


OHIO
RIVER
GREEN RIVER
U.S. 60
HENDERSON
HENDERSON
PENNYRILE PARKWAY
U.S. 41
CANOE CR
SEBREE
DEER CR
DEER CR
EAST FORK
PANTHER
CREEK
KNOBLICK CR
DELAWARE CR
GREEN RIVER
LONG FALLS CR
CANE RUN
CALHOUN
KY 138
MCLEAN
CYPRESS
POND RIVER
BUCK CR
LIVERMORE
ROUGH RIVER
OWENSBORO
L & N R R
U.S. 431
U.S. 231
TWOMILE CR
SOUTH FORK
NORTH FORK PANTHER
DAVIESS
JOES RUN
BLACKFORD
BARNETT CR
ROUGH R.
MUDDY CREEK
HARTF
BEAVER DAM
I.C. R.R.
L F
1
2
2
2
2
4
4
4
5
5
5
5
6
6
7
7
7
7
7
7
7
7
8
8
8
9
9
9
9
11


N
6
HAWESVILLE
7
BLACKFORD
2
L F
U.S. 60
7
6
HANCOCK
12
CREEK
7
7
OWENSBORO
L F
JOES RUN
9
NORTH FORK PANTHER
5
L F
2
EK
L & N R R
DAVIESS
7
CREEK
4
SOUTH FORK
5
DESEATER
PANTHER
TWOMILE CR
U.S. 341
9
U.S. 231
12
ADAMS
FORK
HALLS CR
MISTAKEN CR
CANEY CR
BARNETT CR
BUCK CR
LIVERMORE
ROUGH R
OHIO
4
ROUGH
RIVER
HARTFORD
MUDDY
5
CREEK
11
L F
U.S. 62
I.C.R.R.
12
H.R.R.
BEAVER DAM
KENTUCKY PARKWAY


OHIO RIVER
POND CR.
HENDERSON
8
2
HENDERSO
CREEK
3
7
2
MORGANFIELD
U.S. 60
BEAVERDAM CR.
U.S. 41A
CANOE CR.
U.S. 41
PENNYRILE PARKWAY
CASEY
3
7
8
9
1
CREEK
3
UNION
7
U.S. 60
2
4
SEBREE
5
GREE
DITCH
10
2
STURGIS
10
WEBSTER
DEER CR.
5
9
TRADEWATER
KY. 109
DIXON
CLAY
CR.
8
CRAB ORCHARD
5
SLOVER
CR.
DEER
EAST FORK
RIVER
PROVIDENCE
4

SOIL ASSOCIATION LEGEND

SOILS FROM ALLUVIUM ON STREAM TERRACES AND FLOOD PLAINS. Nearly level, well drained to poorly drained soils.

1. Huntington - Egam - Newark
2. Uniontown - Dekoven - Henshaw
3. Wakeland - Dekoven - Adler
4. Karnak - McGary - Melvin
5. Falaya - Waverly
6. Elk - Ginat - Captina

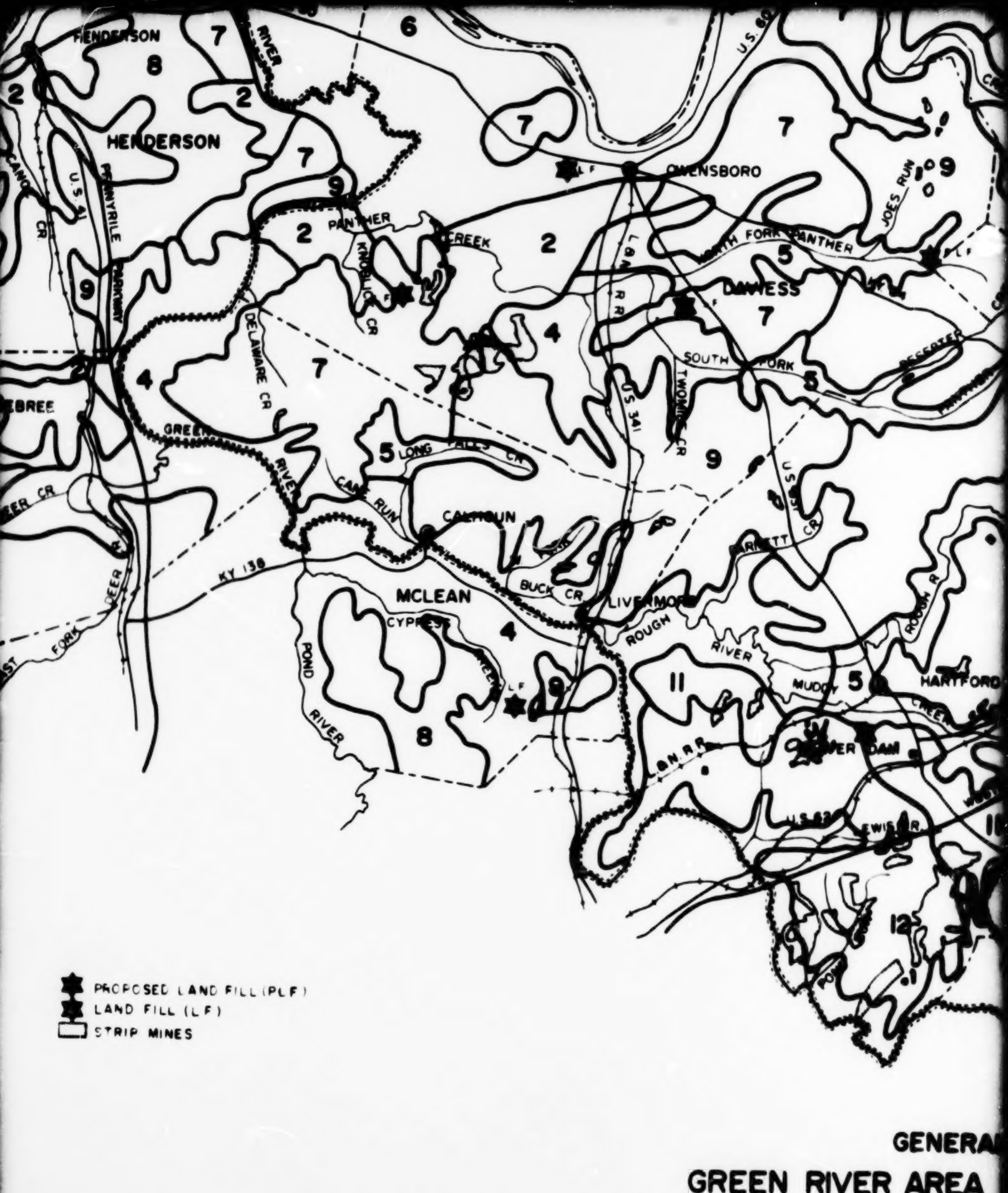
SOILS FROM LOESS ON UPLANDS AND LOCAL ALLUVIUM. Level to steep somewhat poorly drained to well-drained soils.

7. Memphis - Loring - Wakeland
8. Loring - Grenada
9. Loring - Wellston

SOILS FROM SANDSTONE AND SHALE WITH THIN LOESS. Moderately well drained to excessively drained, gently sloping to steep soils.

10. Memphis - Wellston - Dekalb
11. Zanesville - Sadler - Wellston
12. Zanesville - Wellston - Weikert

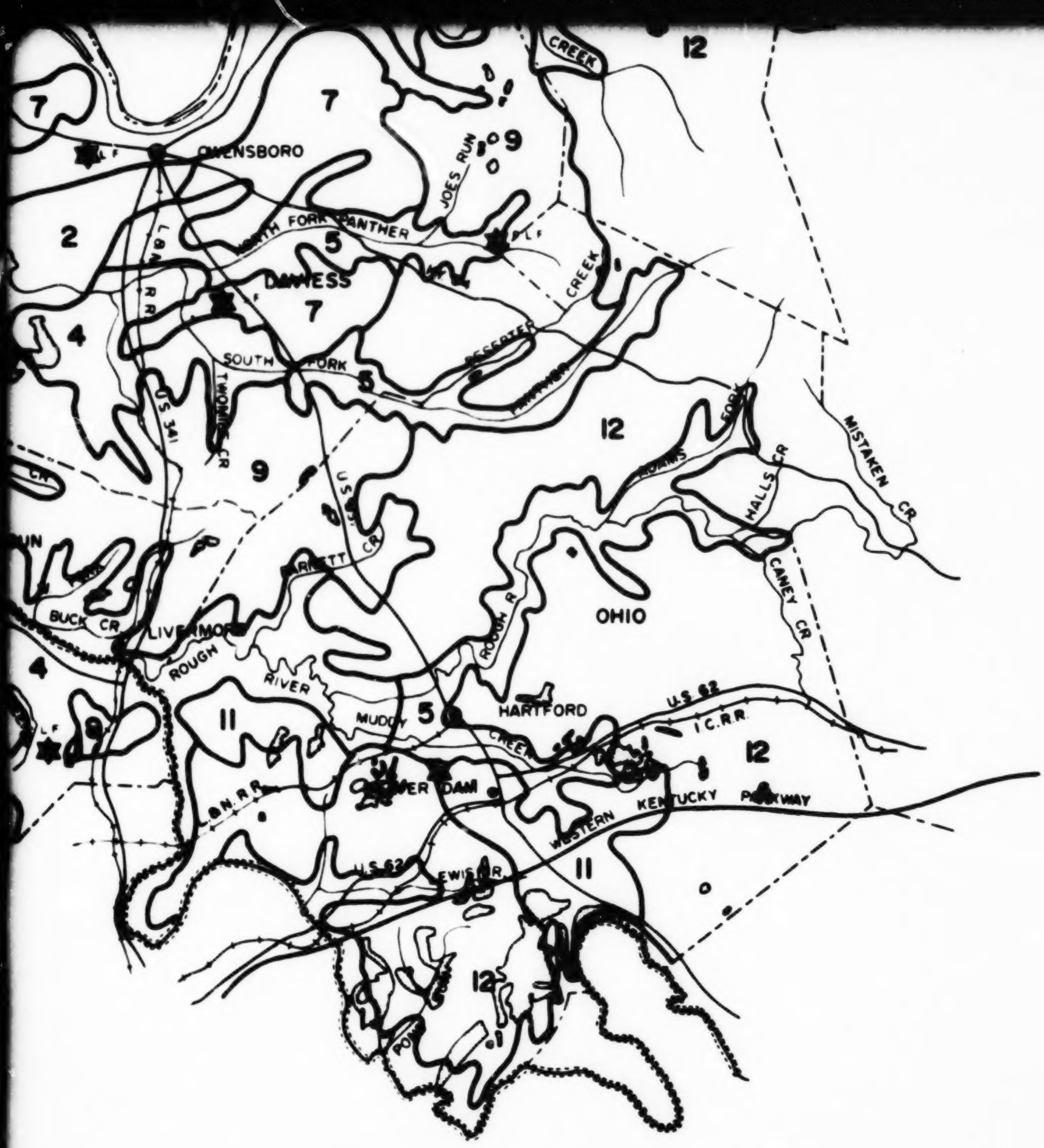
PROPOSED LA
LAND FILL (L
STRIP MINES
5
0


HENDERSON
HENDERSON
RIVER
U.S. 60
OWENSBORO
L.F.
JOES RUN
CANOE CR
U.S. 41
PENNYRILE PARKWAY
PANTHER CREEK
KNOBLICK CR
NORTH FORK PANTHER
DAVIESS
DELAWARE CR
SOUTH FORK
DESERTER CR
L & N R.R.
US 341
TWOMILE CR
GREEN RIVER
LONG FALLS CR
CANE RUN
CALHOUN
BARNETT CR
ROUGH R
DEER CR
KY 138
MCLEAN
BUCK CR
LIVERMORE
CYPRESS CREEK
ROUGH RIVER
POND RIVER
MUDDY CREEK
HARTFORD
CENTER DAM
L & N. R.R.
U.S. 62
LEWIS CR
EAST FORK DEER CR
1
2
4
5
6
7
8
9
11
12
PROPOSED LAND FILL (PLF)
LAND FILL (LF)
STRIP MINES
Scale 1:250 000
0
5
10
15
20 Miles

GENERA

GREEN RIVER AREA

KEN

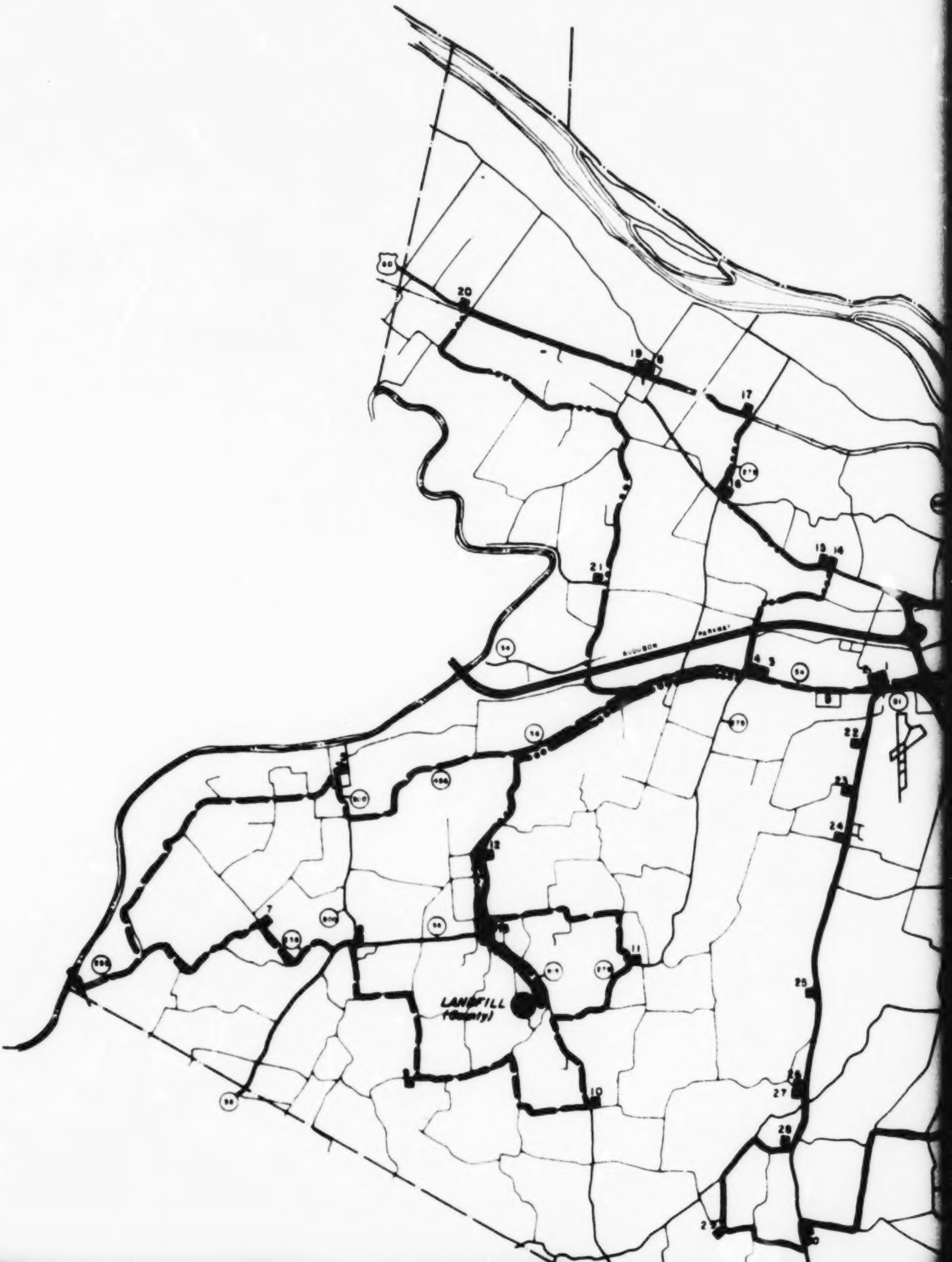

12
CREEK
7
7
OWENSBORO
L F
JOES RUN
9
2
NORTH FORK PANTHER
5
L F
L&N R.R.
DAVIESS
CREEK
7
4
DESERTER
SOUTH FORK
5
PANTHER
TWOMILE CR
US 341
12
FORK
ADAMS
MISTAKEN CR
HALLS CR
CR
9
US
BARNETT CR
RUN
CANEY CR
OHIO
BUCK CR
LIVERMORE
ROUGH R
ROUGH
RIVER
4
11
MUDDY
5
HARTFORD
U.S. 62
I.C.R.R.
L F
CREEK
12
BEAVER DAM
L&N R.R.
WESTERN KENTUCKY PARKWAY
U.S. 62
LEWIS CR.
11
12
POND

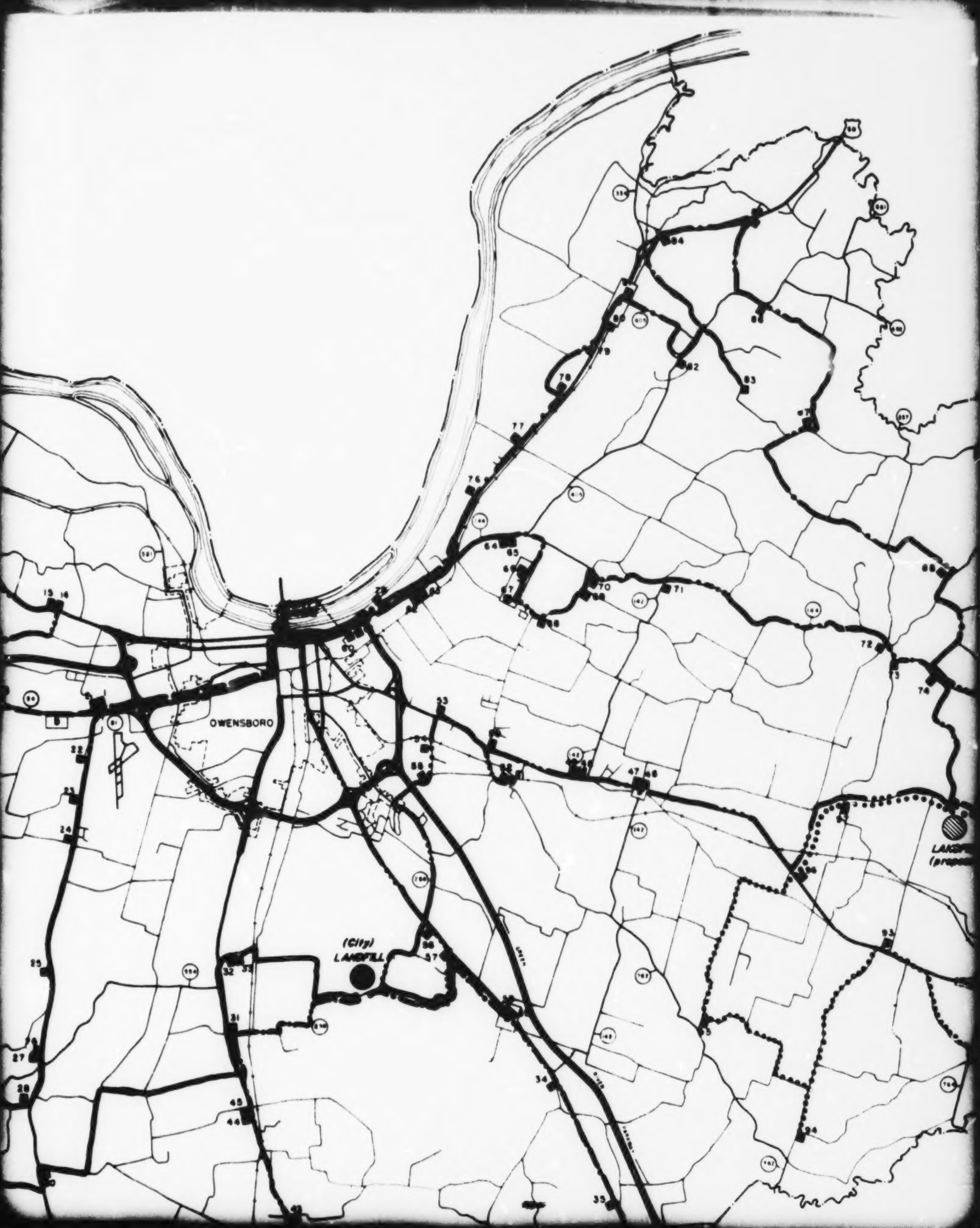
GENERAL SOIL MAP

GREEN RIVER AREA DEVELOPMENT DISTRICT

KENTUCKY

20 Miles


60
20
19
17
16
13
14
21
AUDUBON PARKWAY
56
4
5
60
1
22
23
24
12
7
11
LANDFILL
(County)
10
25
27
28


OWENSBORO
(City) LANDFILL
LANDFI
(propos
13
14
22
23
24
25
27
28
31
32
33
34
35
45
44
47
48
56
57
64
65
66
67
68
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72
73
74
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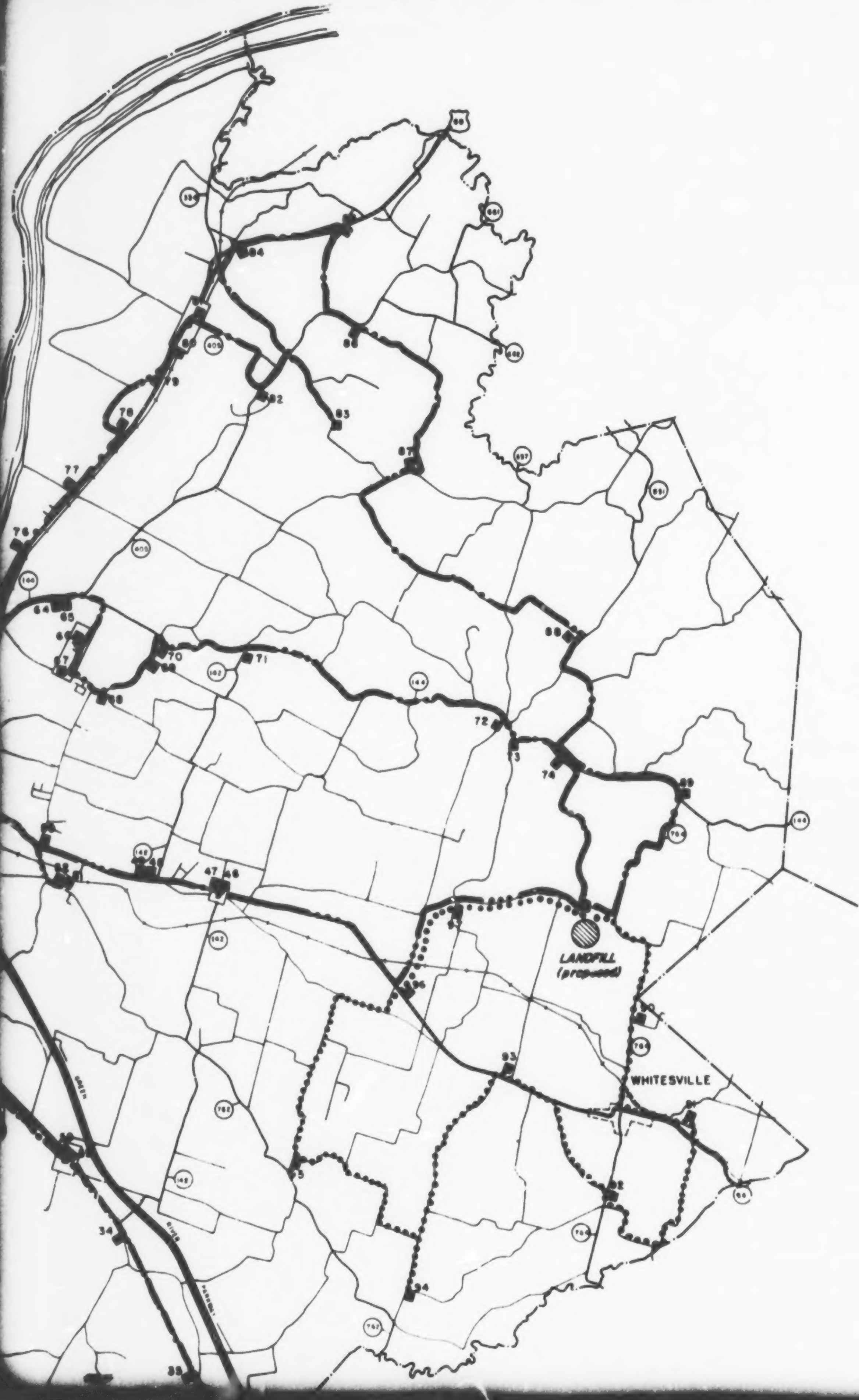
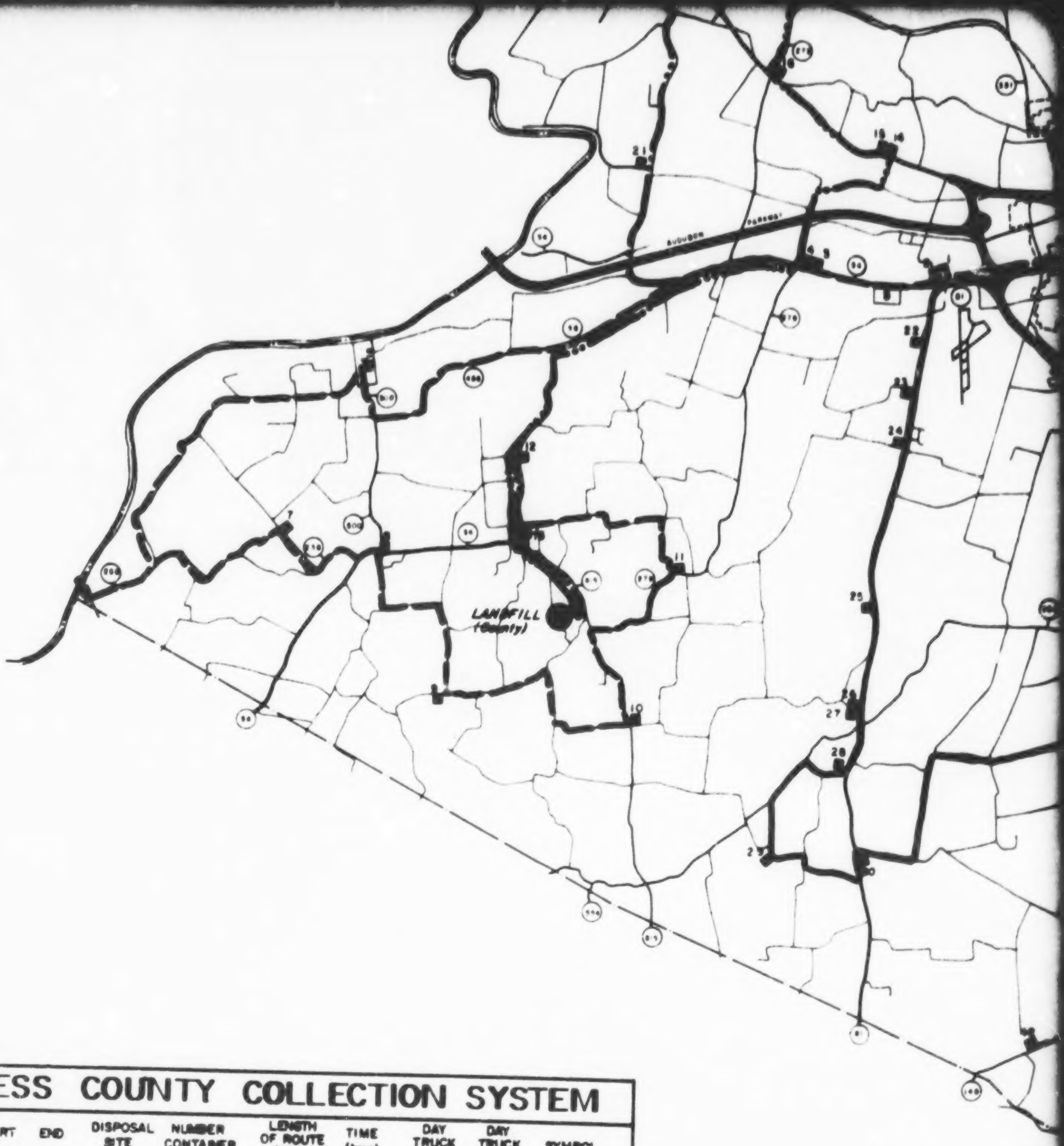
84
86
87
93
144
60
81


LANDFILL
(proposed)
WHITESVILLE
60
64
65
70
71
72
73
74
76
77
78
79
80
81
82
83
84
86
87
89
93
94
96
47
48
34
35
144
405
762
764
704


AUDUBON PARKWAY
LANDFILL
(County)
21
15 16
4 5
22
23
24
25
26
27
28
29
12
7
10
11
56
81

DAVIESS COUNTY COLLECTION SYSTEM

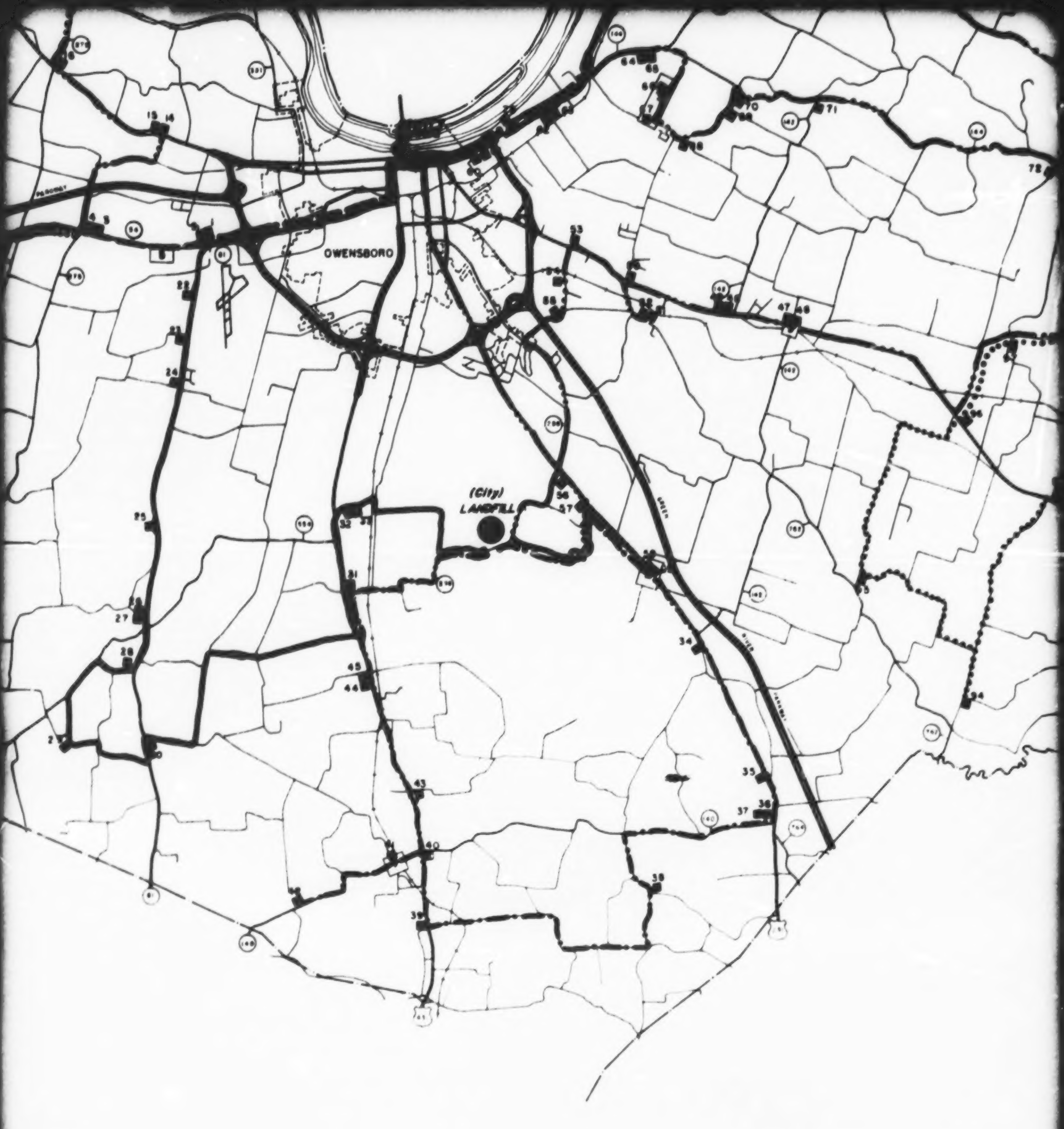
ROUTE	START	END	DISPOSAL SITE	NUMBER CONTAINER	LENGTH OF ROUTE (miles)	TIME (hour)	DAY TRUCK 1	DAY TRUCK 2	SYMBOL
1	GARAGE	CO. L.F.	CO. L.F.	13	40	3.00	M-Th		━━━ ━━━ ━━━
2	CO. L.F.	GARAGE	CO. L.F.	6	-50	3.00	M-Th		━━━ •• ━━━
3	GARAGE	CITY L.F.	CITY L.F.	12	22	2.50	T-F		━━━━━━━━━
4	CITY L.F.	GARAGE	CITY L.F.	12	30	3.00	T-F		━ • ━ • ━ • •
5	GARAGE	PROS. L.F.	PROS. L.F.	15	22	2.50		W-SAT	━━━ ••• ━━━
6	PROS. L.F.	PROS. L.F.	PROS. L.F.	8	33	2.50		W-SAT	━━━ •━• ━━━
5	PROS. L.F.	GARAGE	CITY L.F.	14	31	2.50		W-SAT	━━━ • ━━━
7	GARAGE	GARAGE	PROS. L.F.	18	65	4.50		T-F	••••••••••

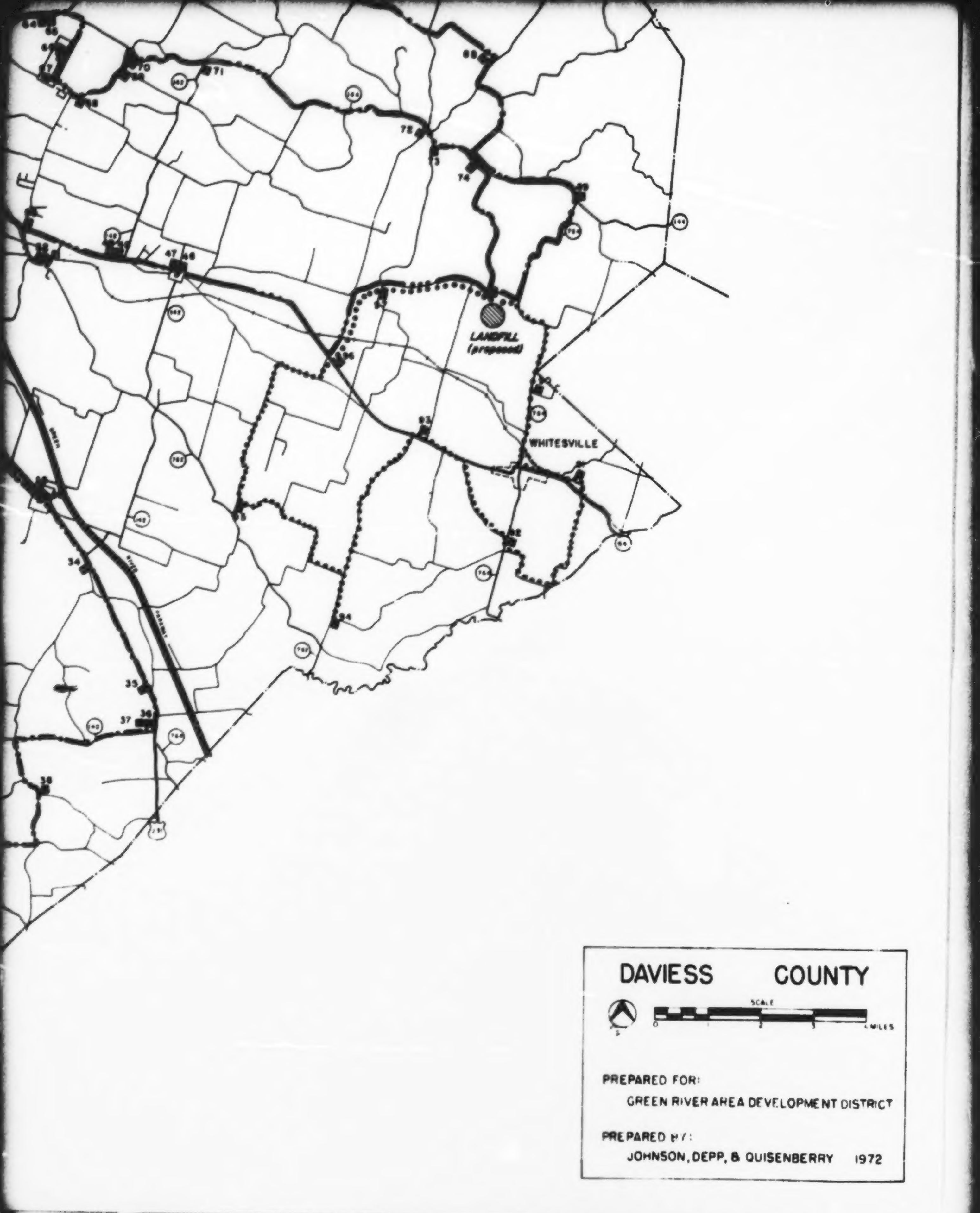
PROPOSED LANDFILL (PROS. L. F.) ▨

COUNTY GARAGE ⬢

EXISTING LANDFILL ●

CONTAINERS ■

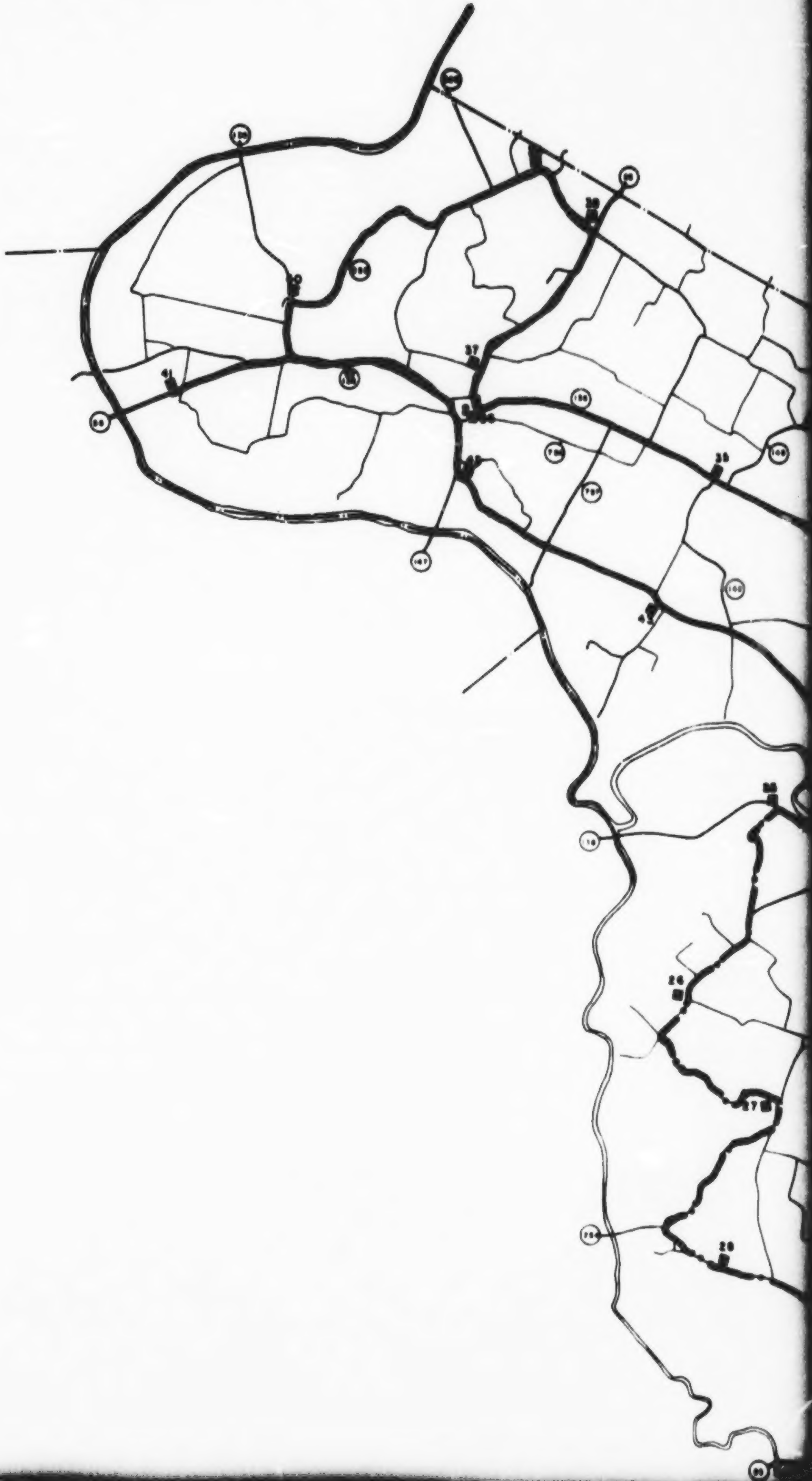

OWENSBORO
(City)
LANDFILL
PARKWAY
15 14
4 5
22
23
24
25
26
27
28
31
32
33
34
35
36
37
38
39
40
43
44
45
47 48
53
55
56
57
64
65
70
71
72

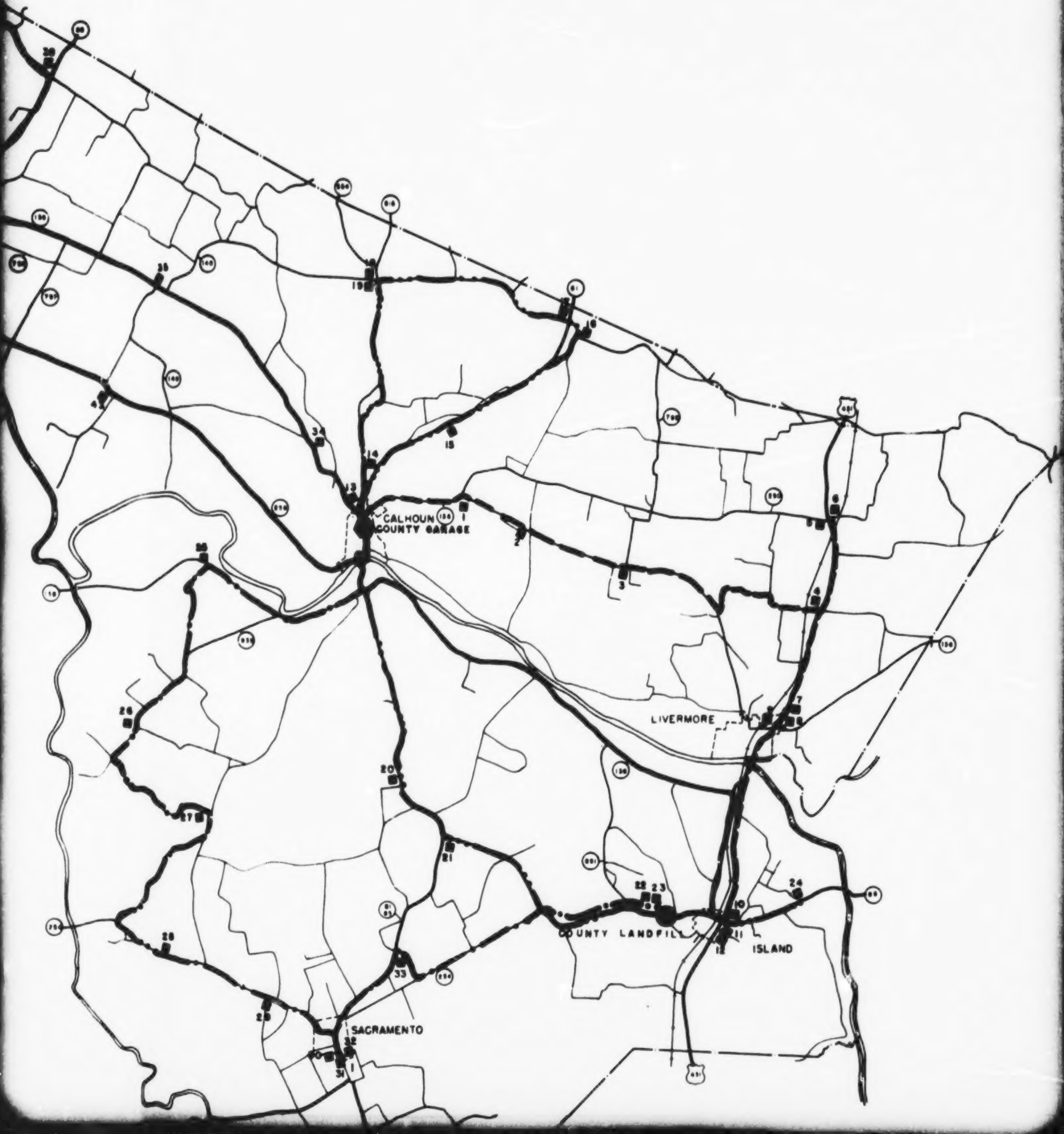

LANDFILL
(proposed)
WHITESVILLE
764
54
231
140
SCALE
0
1
2
3
4 MILES

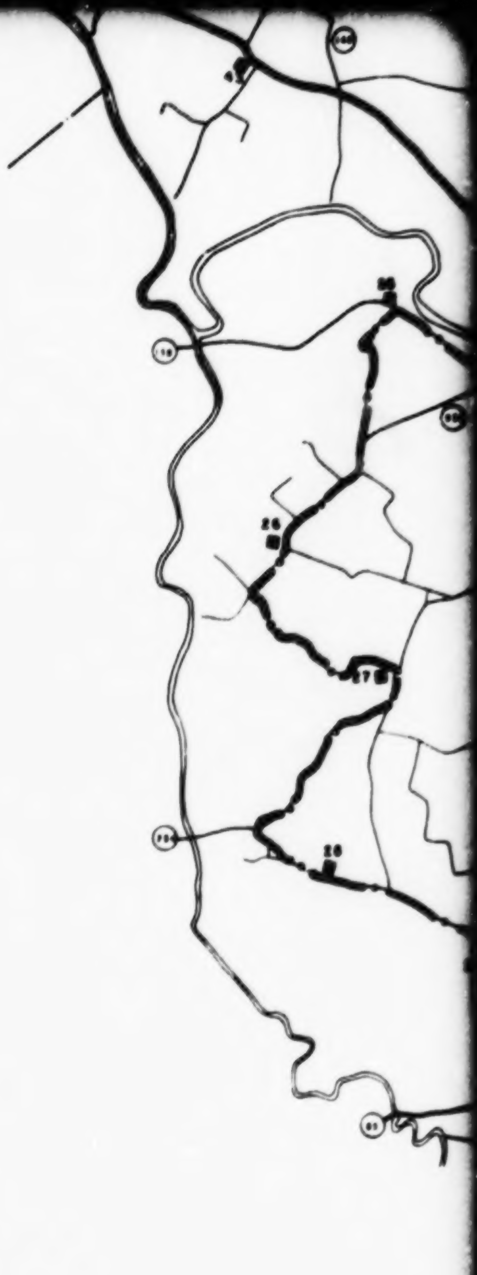
DAVIESS COUNTY

PREPARED FOR:
GREEN RIVER AREA DEVELOPMENT DISTRICT

PREPARED BY:
JOHNSON, DEPP, & QUISENBERRY 1972


37
41
35
147
25
26
27

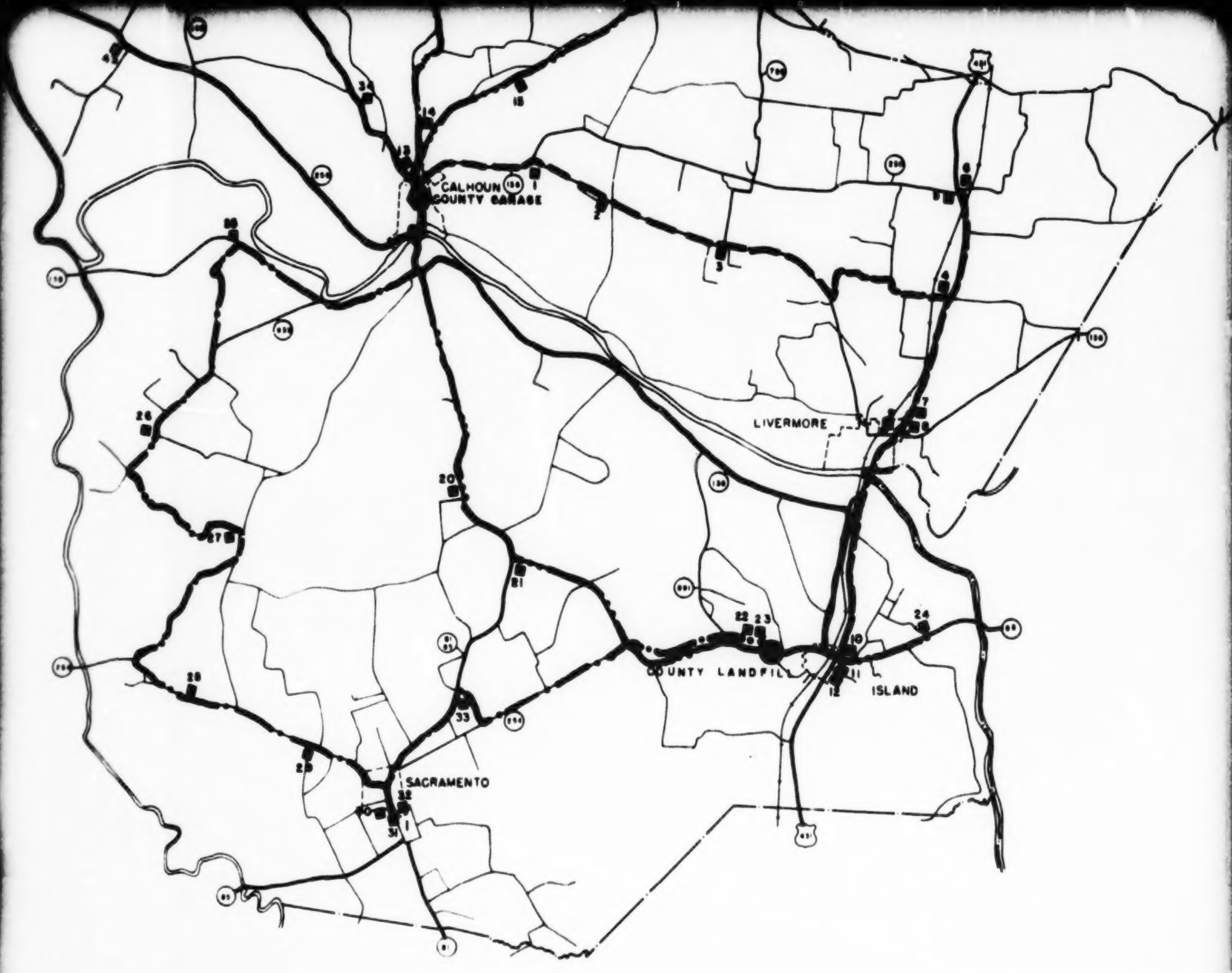

CALHOUN COUNTY GARAGE
LIVERMORE
COUNTY LANDFILL
ISLAND
SACRAMENTO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
19
20
21
22
23
24
25
26
27
28
30
31
32
33
34
35
36
136
431
81

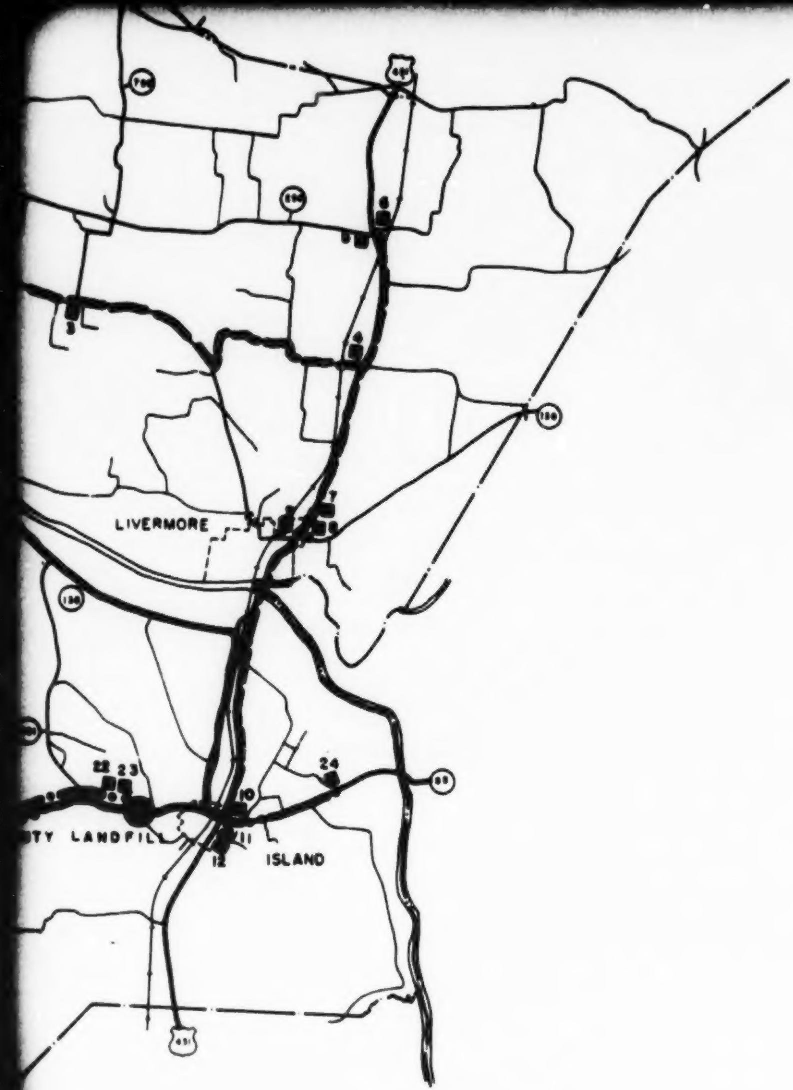


McLEAN COUNTY COLLECTION SYSTEM

ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME HR MIN	DAY	SYMBOL
1	12	19	3 00	MONDAY	— — —
2	12	25	3 30	MONDAY	—•• —
3	9	30	2 30	THURSDAY	—• —
4	10	45	4 00	THURSDAY	———

LANDFILL ● COUNTY GARAGE ⬢ CONTAINERS ■


CALHOUN
COUNTY GARAGE
LIVERMORE
COUNTY LANDFILL
ISLAND
SACRAMENTO
1
2
3
4
5
6
7
8
10
11
12
13
14
15
20
21
22
23
24
26
27
28
29
31
32
33
34
35
431
136
256
81


431
136
3
6
9
4
7
LIVERMORE
136
22
23
24
10
TY LANDFILL
11
12
ISLAND
431

McLEAN COUNTY

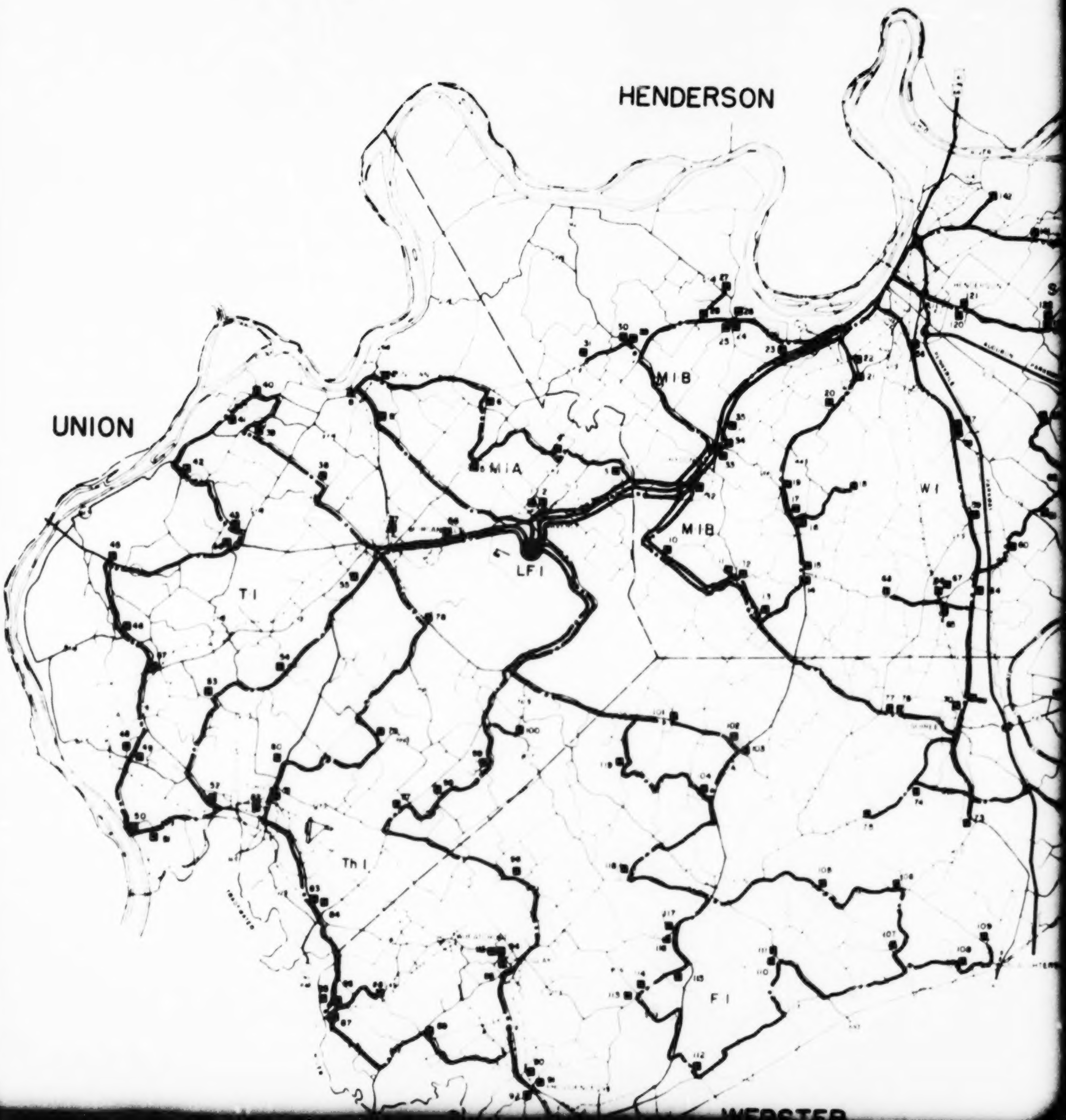
SCALE
0 1 2 3 4 MILES

PREPARED FOR:
GREEN RIVER AREA DEVELOPMENT DISTRICT

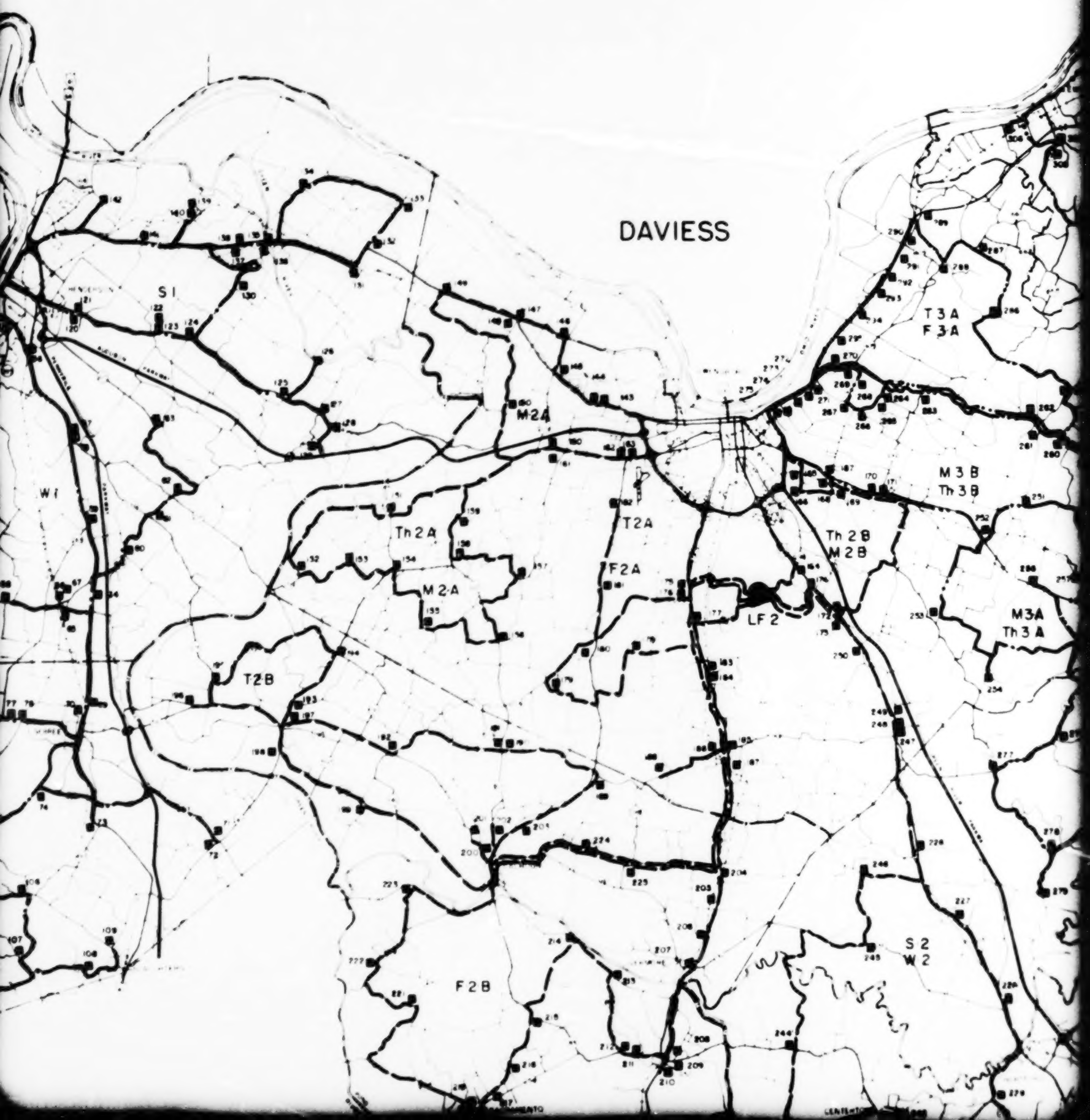
PREPARED BY:
JOHNSON, DEPP, & QUISENBERRY 1972

GREEN RIVER

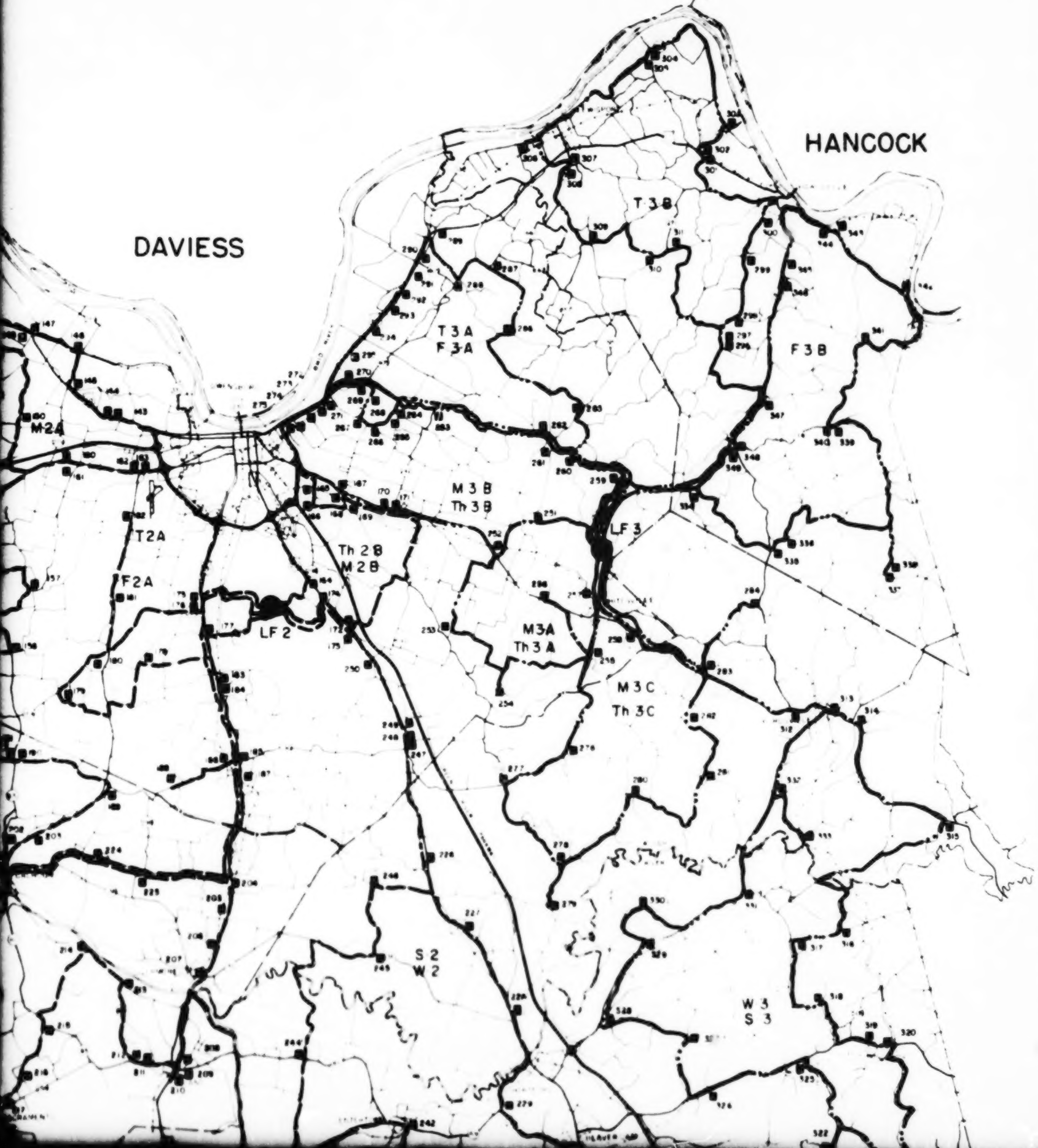
REGIONAL SOLID

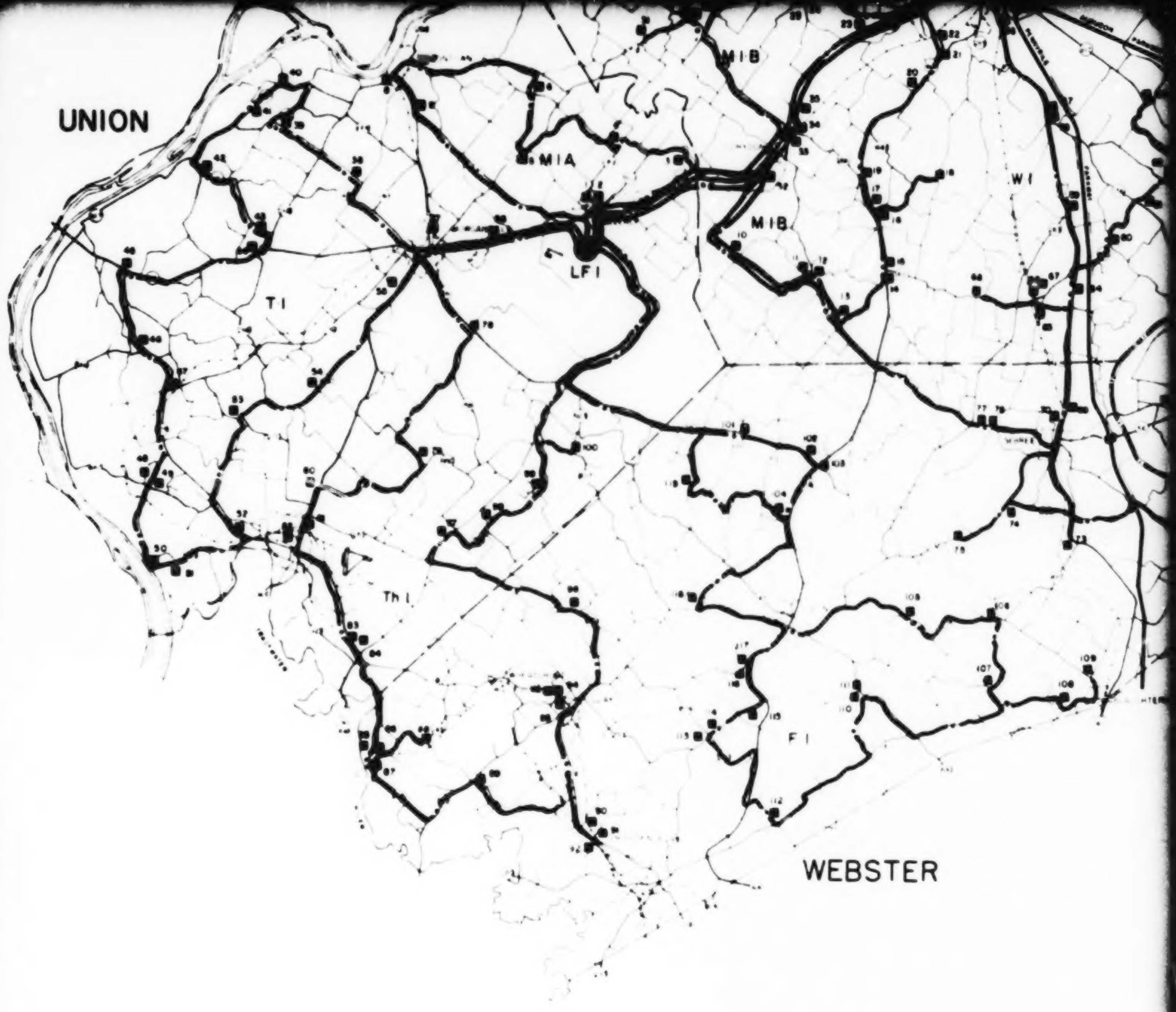

HENDERSON
UNION
M I B
M I A
M I B
L F I
T I
W I
Th I
F I
WEBSTER

RN RIVER AREA DEVELOPMENT DISTRICT
NAL SOLID WASTE COLLECTION SYSTEM


DAVIESS
S1
W1
M2A
Th 2 A
M 2 A
T2A
F2A
LF 2
T2B
Th 2 B
M 2 B
T 3 A
F 3 A
M 3 B
Th 3 B
M3A
Th 3 A
S 2
W 2
F 2 B
HENDERSON

NT DISTRICT
ON SYSTEM


DAVIESS
HANCOCK
T 3 B
T 3 A
F 3 A
F 3 B
M 2 A
M 3 B
Th 3 B
T 2 A
F 2 A
LF 3
Th 2 B
M 2 B
LF 2
M 3 A
Th 3 A
M 3 C
Th 3 C
S 2
W 2
W 3
S 3

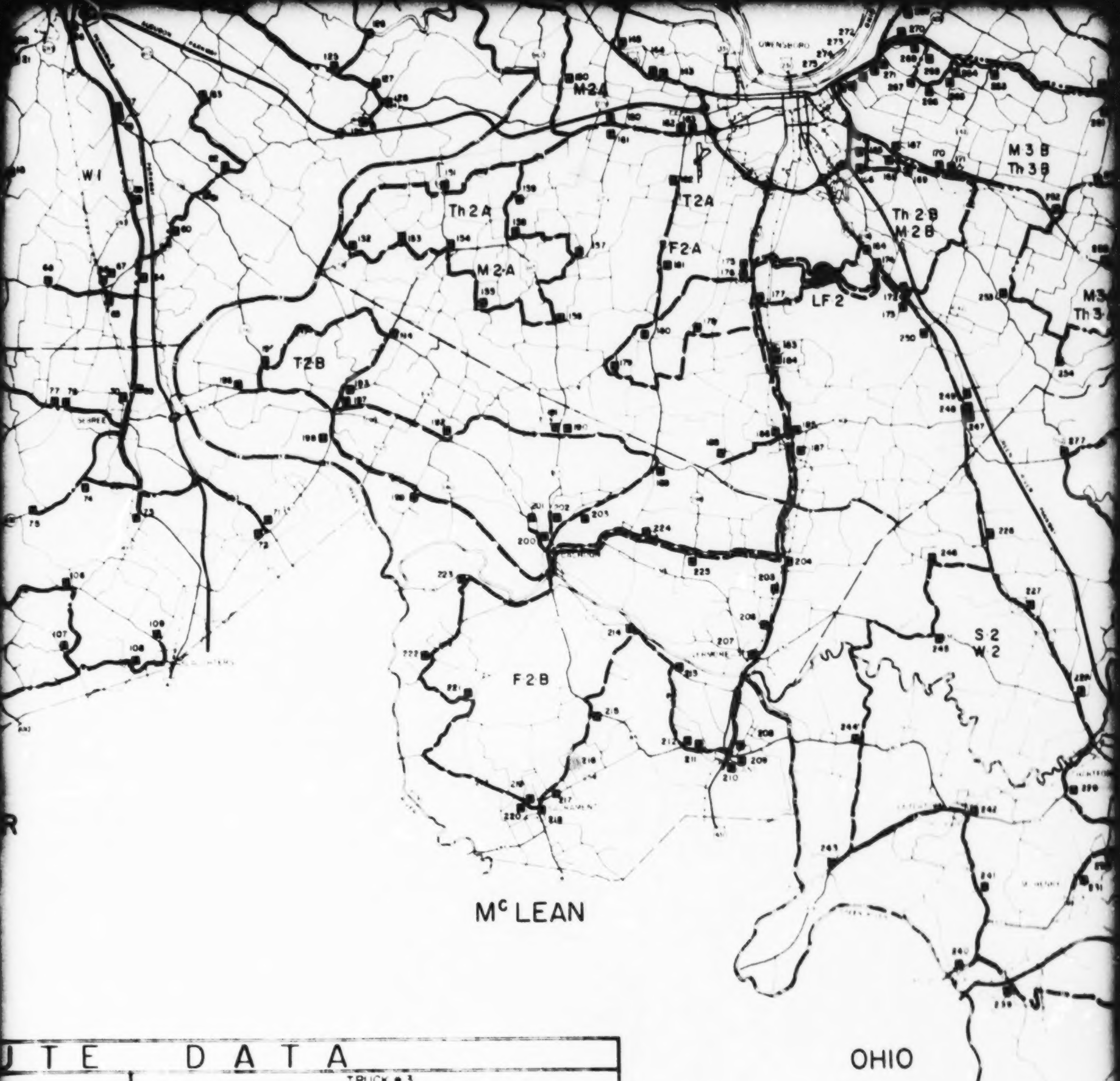


COLLECTION ROUTE D

TRUCK #1					
DAY	ROUTE	NUMBER OF CONTAINERS	TOTAL UNCOMPACTED WASTE VOLUME (CU. YD.)	DISTANCE TRAVELED (MILES)	TIME REQUIRED (HOURS)
MONDAY	M1A M1B	13 22	62 106	38 53	2.50 4.50
TUESDAY	T1	20	96	90	4.00
WEDNESDAY	W1	22	106	105	6.00
THURSDAY	Th1	23	110	100	6.00
FRIDAY	F1	19	91	88	5.00
SATURDAY	S1	23	110	100	5.00
WEEKLY	TOTAL	142	681	541	34.00

TRUCK #2					
DAY	ROUTE	NUMBER OF CONTAINERS	TOTAL UNCOMPACTED WASTE VOLUME (CU. YD.)	DISTANCE TRAVELED (MILES)	TIME REQUIRED (HOURS)
MONDAY	M2A M2B	21 18	100 72	70 20	4.50 2.00
TUESDAY	T2A T2B	10 19	48 91	20 72	2.00 4.50
WEDNESDAY	W2	21	100	100	6.00
THURSDAY	Th2A Th2B	21 18	100 72	70 20	4.50 2.00
FRIDAY	F2A F2B	10 22	48 106	20 72	2.00 4.50
SATURDAY	S2	21	100	100	6.00
WEEKLY	TOTAL	179	837	564	38.00

DAY
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
WEEKLY


OWENSBORO
W·1
M·2A
Th 2 A
M 2·A
T2A
F2·A
M 3 B
Th 3 B
Th 2·B
M 2·B
LF 2
M3
Th 3
T·2·B
F·2·B
S·2
W·2
Mc LEAN
OHIO

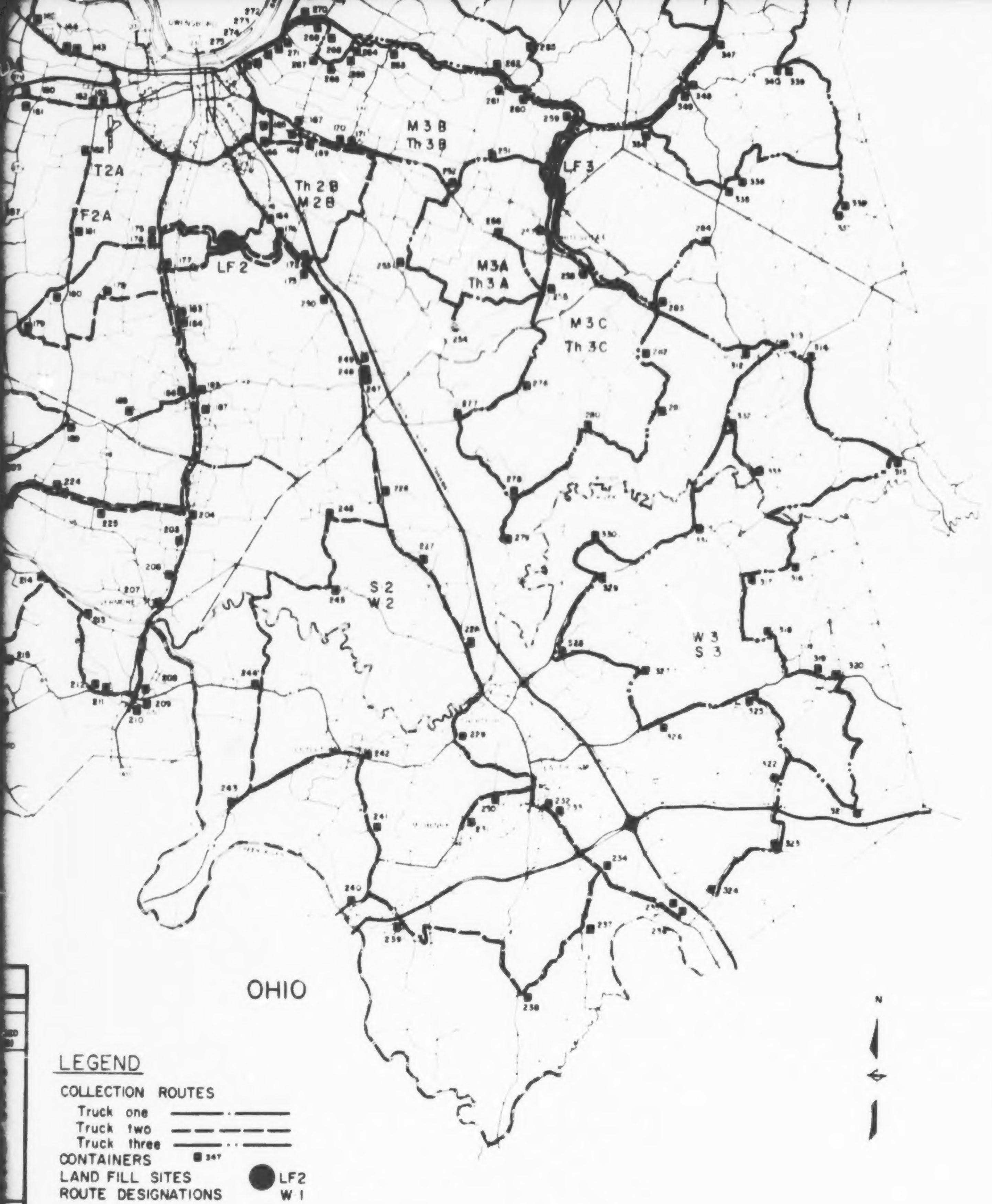
UTE DATA

DISTANCE TRAVELED (MILES)	TIME REQUIRED (HOURS)	DAY	ROUTE	NUMBER OF CONTAINERS	TOTAL UNCOMPACTED WASTE VOLUME (Cu. Yd.)	DISTANCE TRAVELED (MILES)	TIME REQUIRED (HOURS)
		TRUCK # 3					
70	4.50	MONDAY	M 3 A	8	39	24	1.50
20	2.00		M 3 B	17	82	36	3.00
			M 3 C	9	45	45	2.50
20	2.00	TUESDAY	T 3 A	11	53	40	2.50
72	4.50		T 3 B	16	77	58	3.50
100	6.00	WEDNESDAY	W 3	22	108	100	6.00
70	4.50	THURSDAY	Th 3 A	8	38	24	1.50
20	2.00		Th 3 B	17	82	38	3.00
			Th 3 C	9	43	45	2.50
20	2.00	FRIDAY	F 3·A	11	43	40	2.50
72	4.50		F 3 B	16	77	65	3.50
100	6.00	SATURDAY	S 3	22	108	100	6.00
564	38.00	WEEKLY	TOTAL	166	798	600	38.00

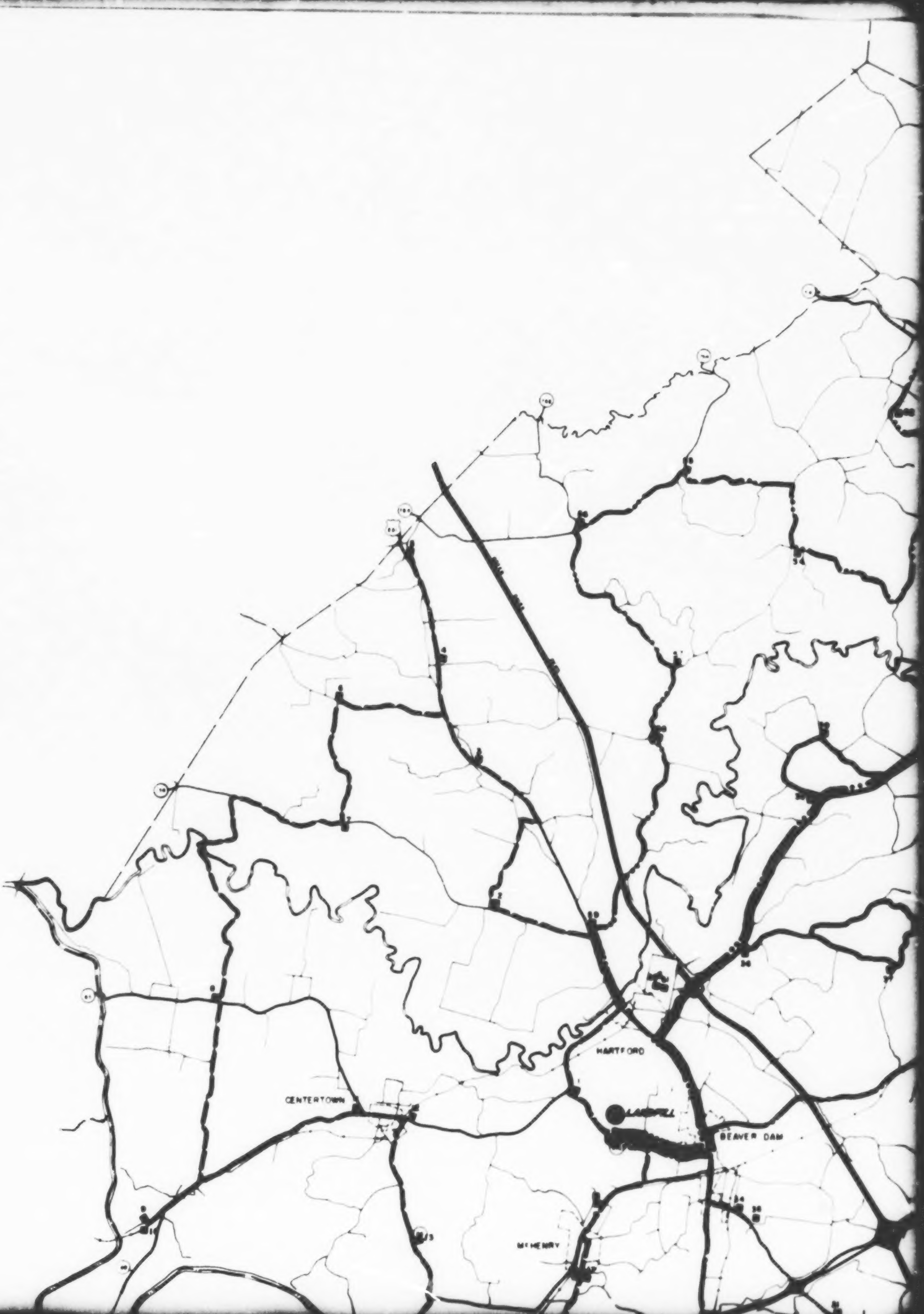
LEGEND

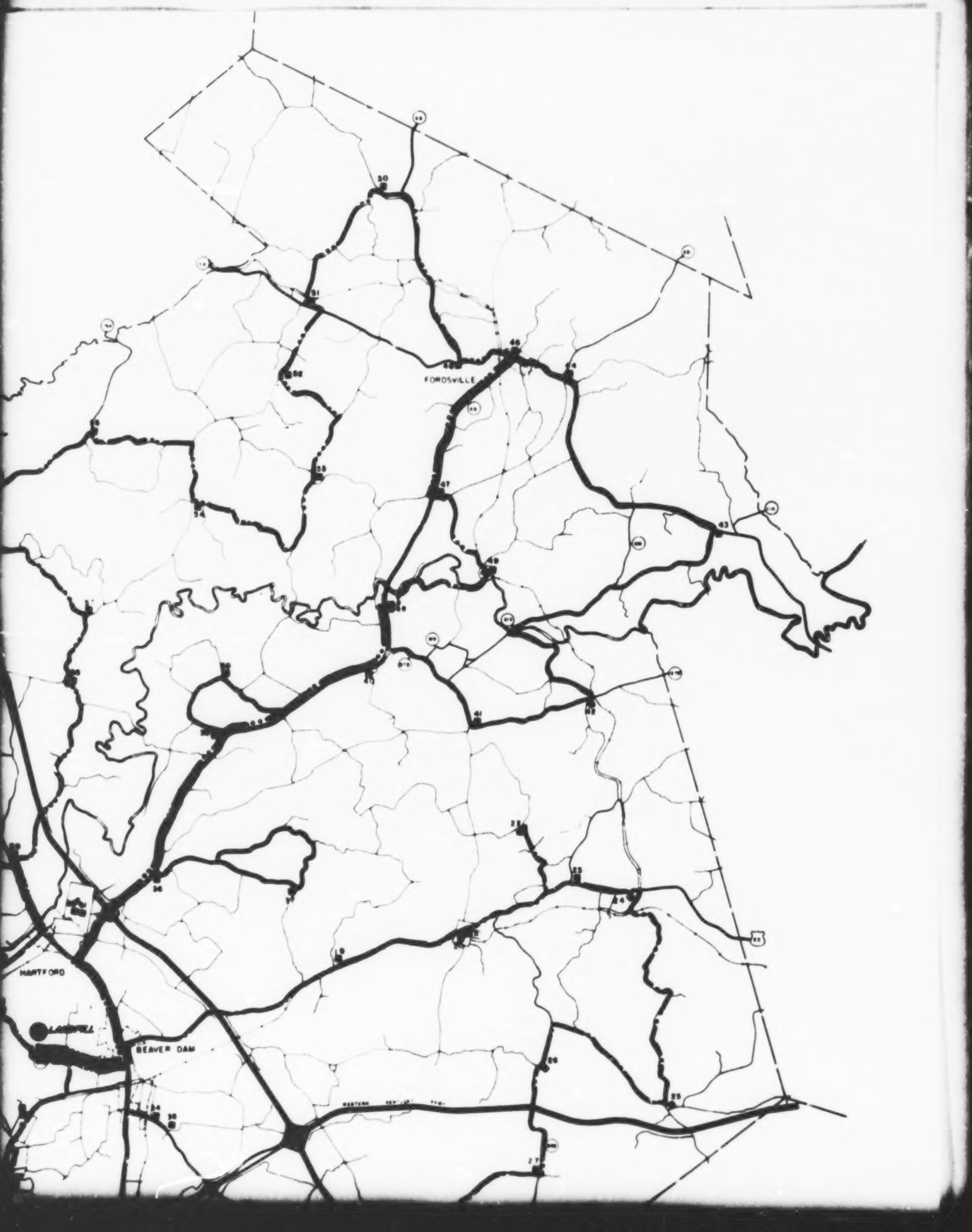
COLLECTION ROUTES

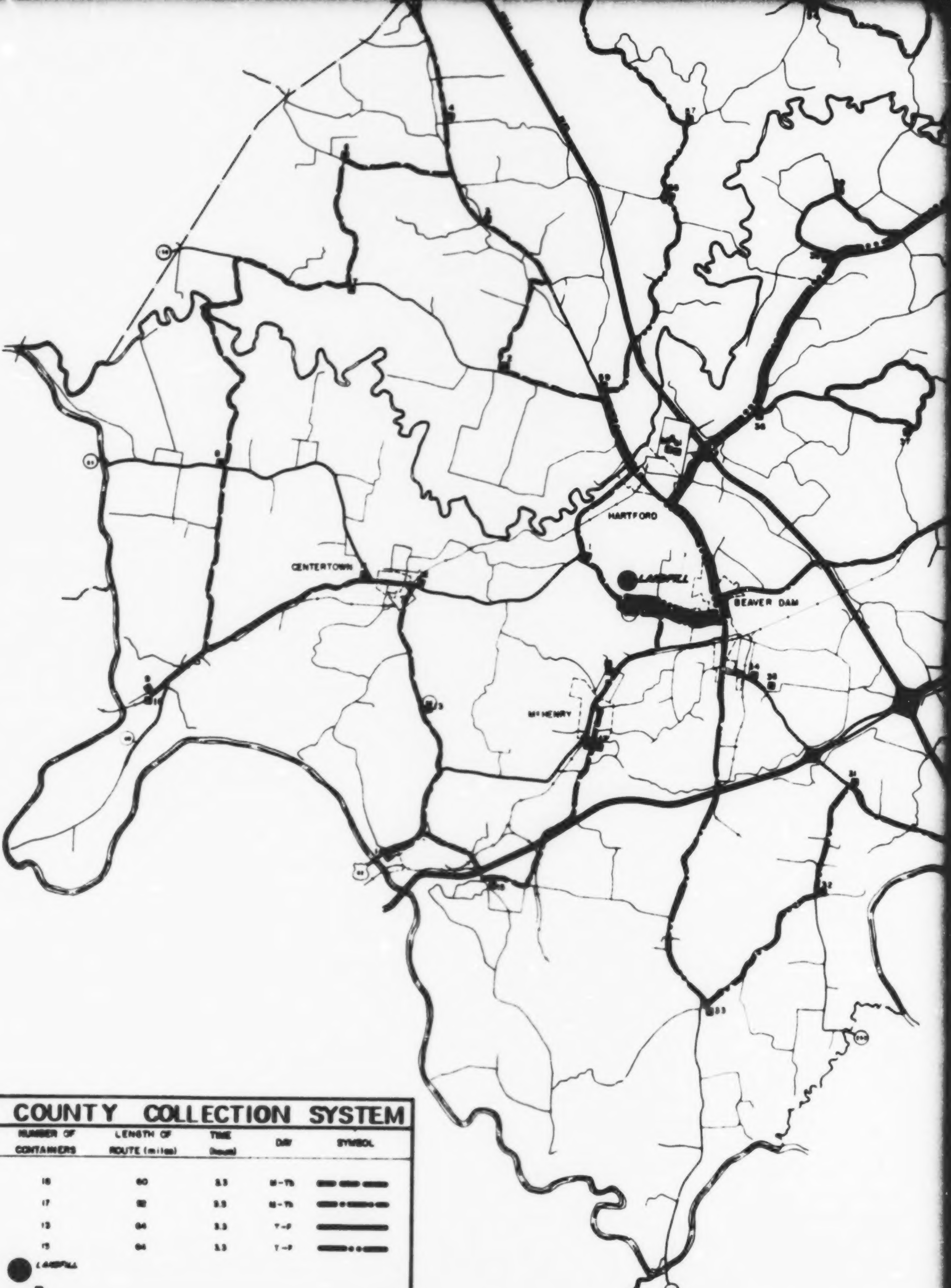
Truck one	—— · ——
Truck two	— — — —
Truck three	—— · · ——
CONTAINERS	■ 347
LAND FILL SITES	● LF2
ROUTE DESIGNATIONS	W·1


OWENSBORO
M 3 B
Th 3 B
T2A
F2A
Th 2 B
M 2 B
LF 2
LF 3
M3A
Th 3 A
M 3 C
Th 3 C
S 2
W 2
W 3
S 3
OHIO
N
LEGEND
COLLECTION ROUTES
Truck one
Truck two
Truck three
CONTAINERS
347
LAND FILL SITES
LF2
ROUTE DESIGNATIONS
W-1

PREPARED BY
JOHNSON, DEPP & QUISENBERRY
CONSULTING ENGINEERS & PLANNERS

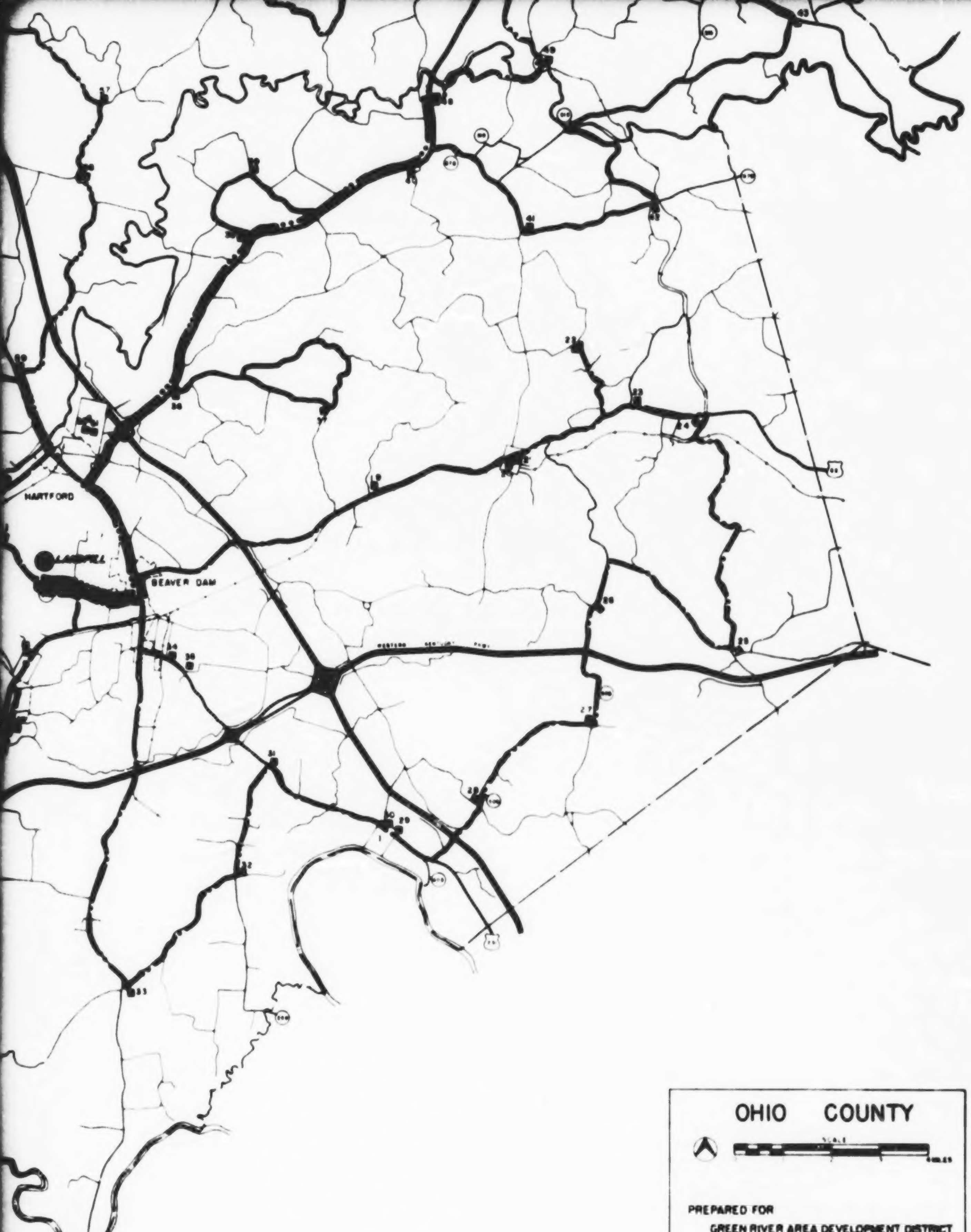

HARTFORD
CENTERTOWN
LANDFILL
BEAVER DAM
McHENRY


30
31
46
FORDSVILLE
32
33
34
47
48
43
41
42
36
22
23
24
19
HARTFORD
BEAVER DAM
26
25
34
35
27


HARTFORD
CENTERTOWN
BEAVER DAM
McHENRY
LANDFILL

OHIO COUNTY COLLECTION SYSTEM

ROUTE NUMBER	NUMBER OF CONTAINERS	LENGTH OF ROUTE (miles)	TIME (hours)	DAY	SYMBOL
1	16	60	3.3	M-Th	▬ ▬ ▬
2	17	92	3.3	M-Th	▬•▬•▬
3	13	64	3.3	T-F	▬▬▬
4	15	64	3.3	T-F	▬••▬
LANDFILL	● LANDFILL				
CONTAINERS	▪				


HARTFORD
BEAVER DAM
OHIO COUNTY
SCALE
PREPARED FOR
GREEN RIVER AREA DEVELOPMENT DISTRICT
PREPARED BY
JOHNSON, DEPP, & QUISENBERRY 1972